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THE ÆTIOLOGY AND GEOGRAPHIC DISTRIBUTION OF INFECTIOUS DISEASES.*

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IN a recent address before a medical audience I defined the term "infectious" as follows:

"It is hardly necessary to say that by 'infectious diseases' we mean those diseases which result from the introduction into the body of some disease-producing agent. And I think we are justified in saying that an essential condition of infection is that the disease-producing agent shall be capable of reproduction in the body of the infected individual—in other words, that it is a living organism. It matters not whether this living organism is large or small; whether it belongs to the animal or vegetable kingdom; whether it is located in the skin as in scabies, in the muscles as in trichinosis, in the lymphatics as in erysipelas, in the solid viscera as in amœbic abscess of the liver, in the intestine as in cholera, or in the blood as in relapsing fever, the introduction and multiplication of the living infectious agent constitutes infection."

The terms contagious and infectious are not synonymous. A disease is contagious when it is transmitted from the sick to the well by personal communication or contact, more or less intimate; and all contagious diseases are infectious—i. e., they are due to the introduction into the body of a susceptible individual of a living germ. But all infectious diseases are not contagious. Thus smallpox, scarlet fever, measles, diphtheria, influenza, etc., are infectious diseases

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which are contagious; while malarial fevers, typhoid fever, yellow fever, cholera, pneumonia, peritonitis, etc., are infectious diseases which are not contagious—at least, they are only contagious under very exceptional circumstances, and those in close communication with the sick as nurses, etc., do not contract these diseases as a result of such close association or contact.

The generalization that all infectious diseases are due to the introduction into the bodies of susceptible individuals of living germs capable of reproduction is based upon exact knowledge, gained chiefly during the past twenty years, as regards the specific infectious agents or germs of a considerable number of the diseases of this class. In some infectious diseases, however, no such positive demonstration has yet been made.

The investigations which have been made justify the statement that each infectious disease is due to a *specific*—i. e., distinct—micro-organism. There are, however, certain infectious diseases which physicians formerly supposed to be distinct, and to which specific names are given which are now known to be due to one and the same infectious agent or germ. Thus puerperal fever and erysipelas are now recognized as being caused by the same germ, the germ which is the usual cause of pneumonia is also the cause of a considerable proportion of the cases of cerebro-spinal meningitis, etc.

In considering the geographic distribution of infectious diseases we will find it necessary to divide them into two groups, one in which the specific infectious agent or germ multiplies only within the bodies of infected individuals, the other in which it also multiplies external to the bodies of infected individuals when conditions as to temperature, moisture, and organic pabulum are favorable for such external multiplication.

In the first group we have all those diseases which are transmitted only by personal contagion, direct or indirect—i. e., by contact with the sick or with articles infected by such contact (fomites). This list includes smallpox, chicken pox, measles, scarlet fever, mumps, whooping-cough, influenza, and diphtheria.

In the second group we have cholera, typhoid fever, yellow fever, and the malarial fevers.

It is evident that the geographic distribution of diseases of the first group will depend chiefly upon conditions relating to the susceptibility of different races of mankind, their knowledge of preventive measures, such as disinfection, vaccination, and isolation of the sick, their mode of life and intercourse with each other and with peoples occupying different geographic areas, etc. Nomadic savages, or people living upon islands remote from the channels of commerce, are less liable to suffer from infectious diseases of foreign

origin than are the denizens of populous regions, and especially of cities having commercial relations with all parts of the world. But when an exotic pestilential disease is first introduced among people who have previously enjoyed an immunity from it, on account of their isolation, it is usually very fatal, owing to the great susceptibility of a virgin population. This is due to the fact that there is no individual immunity resulting from a previous attack, and also to a relatively great race susceptibility as compared with a people among whom the disease has prevailed for many years. It is evident that the continued prevalence of an infectious disease in a given area will have a tendency to reduce the susceptibility of the population, in accordance with the laws of natural selection and survival of the fittest.

In illustration of this I may mention the comparative immunity of the African race to malarial fevers, which are so fatal to Europeans who visit the malarious regions of the African coast and interior; and the immunity of the native ("creole") population of those cities where yellow fever prevails as an endemic disease, as at Havana, Vera Cruz, and Rio de Janeiro.

What has been said will suffice to show that the geographic distribution of infectious diseases is to some extent influenced by the relative susceptibility of the population in various regions. The prevalence of the strictly contagious diseases also depends to some extent upon climatic conditions, although to a far less degree than is the case in our second group, which includes diseases in which the germ may multiply external to and independently of infected individuals.

In general, contagious diseases are more likely to spread in northern latitudes, and during the winter season, because the climatic conditions lead to the aggregation of individuals in towns and in closed apartments, while in southern latitudes and during the summer season a larger proportion of the population live in the open air during the daytime and sleep in well-ventilated rooms at night.

The influence of season upon the prevalence of smallpox, a strictly contagious disease, has been referred to by numerous authors, and is insisted upon by Hirsch in his Handbook of Geographical and Historical Pathology. In a table contained in the monumental work of Hirsch the season is given in which ninety-nine epidemics of smallpox reached their height. In sixty-seven it was during the cold season and in thirty-two during the warm season. The same thing is shown by the mortuary statistics of various civilized countries. The immunity resulting from vaccination has largely influenced the geographic distribution of smallpox epidemics, which are now almost unknown in Germany and are comparatively infre-

quent in the United States, in England, and in other countries where the value of vaccination is pretty generally recognized.

The influence of climate, and therefore of geographic distribution, upon the prevalence of certain diseases is due to its effect in increasing individual susceptibility to infection. Thus the susceptibility to influenza, to diphtheria, and to pneumonia is increased by exposure, leading to a sudden refrigeration of the body. These diseases are for this reason most prevalent in northern latitudes and during the seasons when by reason of exposure to sudden changes in the temperature there is the greatest liability to "catch cold."

It will be seen from what has already been said that the ætiology of infectious diseases does not depend alone upon exposure to infection—i. e., upon the presence of the specific infectious agent or germ, which is, however, an essential factor—but that the development of an attack may depend upon other factors which we may include under the general heads of (*a*) predisposing causes and (*b*) exciting causes. Predisposition may be either inherited or acquired. Thus the African race is especially liable to contract smallpox in its most virulent form, and the fair-skinned races of northern Europe are especially subject to fatal attacks of yellow fever. Again, certain families have a hereditary predisposition to pulmonary consumption, while others are especially liable to repeated attacks of smallpox in the same individual, etc. Youth constitutes a predisposition to certain diseases, the liability to attack being greatly diminished for scarlet fever and whooping-cough after adolescence and for tuberculosis after forty years of age. An acquired predisposition may be due to starvation or an inadequate diet as regards certain essential elements, to excessive fatigue or nervous exhaustion from any cause, to loss of blood, to alcoholic excesses, to insanitary surroundings, and in short to any of the causes which lower the vital resisting power of the individual. When such causes are general in their operation, or in times of famine, epidemics are likely to prevail, and the geographic range of these epidemics will coincide with the area in which the predisposing cause is effective.

As instances of the development of an attack from the direct action of an exciting cause (*b*), the specific germ being present, we may mention the effect of a recent debauch in causing an attack of yellow fever, of exposure to cold as the immediate cause of an attack of pneumonia or of influenza, of an attack of indigestion in developing a case of Asiatic cholera, of an injury to a joint as the exciting cause of a tubercular joint disease, etc.

What has already been said will show that the question of the geographic distribution of infectious diseases could hardly have been considered independently of questions relating to the ætiology or

causation of these diseases. This will become still more apparent when we come to speak of the geographic range of infectious diseases in which there is an external development of the specific infectious agent, for such development is strictly limited by conditions relating to climate, soil, elevation above the sea level, etc. Thus yellow fever, cholera, and the malarial fevers are essentially diseases of warm countries, or of the summer season in those portions of the temperate zone in which they prevail.

Having thus called attention in a general way to the factors which influence the geographic distribution of infectious diseases, I shall now ask your attention to a brief account of some of the more important of these diseases considered separately, and in doing so it will be necessary to refer also to their geographic distribution in past times, or, in other words, to the history of epidemics.

Epidemic influenza, or as the French call it *la grippe*, is a disease which has frequently prevailed in all parts of the civilized world, and can not be said to have any definite geographic habitat. In this regard it corresponds with smallpox and other contagious diseases, but it is only during recent years that the fact of its transmission by personal contagion has been generally recognized by physicians, and indeed it is still denied by some. This fact, however, I consider to be well established. While references to this disease are found at a much earlier period, it was not until the year 1173 that it was described with sufficient accuracy by medical writers to justify the epidemic of that year in Italy, Germany, and England to be included in a tabular list of epidemics given by Hirsch. From that time to the present very numerous epidemics have occurred. Some of these have been limited to the eastern hemisphere, or to a restricted portion of it, while others have extended to the western hemisphere and have gained a wide prevalence on this side of the Atlantic, notably so the recent prolonged epidemic which dates from 1889. If we look at a list of the recorded epidemics during the present century we shall find that the disease has probably never been entirely absent from some portion of the eastern hemisphere, although it has been comparatively restricted in its range at times, and has again gained a wide extension in Europe and Asia, and has on numerous occasions crossed the Atlantic and invaded the western hemisphere. This occurred in 1807, 1815, 1824, 1830, 1832, 1843, 1848–'51, 1857, and in 1873–'75.

Bubonic plague is a fatal infectious disease which prevails at the present day in certain portions of China and other Oriental countries, and which in the past has prevailed as a devastating pestilence in Asia and Europe. Recent researches by the Japanese bacteriologist Kitasato and by the French bacteriologist Yersin have

demonstrated the fact that the bubonic plague is due to a bacillus. No doubt the present limited geographic range of this pestilential disease is due to the great sanitary improvements which have occurred in European countries during the past two centuries. The experiments of Yersin show that rats become infected and die when they are fed upon portions of the body of victims of the plague. He also demonstrated the presence of the plague bacilli in dead rats found in the houses and streets of Hong Kong. This may account for the perpetuation of the disease in a country where rats abound, and where the victims of the plague are no doubt frequently exposed to the attacks of these voracious animals. The epidemics of plague which have occurred in Europe, so far as we are able to trace them, appear to have had their origin in the Orient. The French commissioners who were sent to Egypt in 1828 to study plague arrived at a conclusion which is in consonance with our suggestion that rats may play an important part in perpetuating the malady. Their researches convinced them that plague was unknown in Egypt previous to the year 543 (A. D.), and that its first appearance corresponds with the time when the Egyptians discontinued the practice of embalming the dead, and resorted to burial in the earth, which among the poorer classes is commonly done in a manner so inadequate that the atmosphere around a graveyard is usually filled with the products of cadaveric decomposition.

The pestilential disease which prevailed so extensively in Europe during the middle ages, and which was known everywhere as the *black death*, caused an enormous loss of life. This disease is now believed by epidemiologists to be identical with the bubonic plague of the Orient. No doubt, however, other pestilential maladies, and especially typhus, or "spotted fever," were confounded with the prevailing epidemic disease. The last-mentioned disease is sometimes known as "famine fever," on account of its liability to prevail in epidemic form during periods of scarcity of food. Typhus was not recognized by physicians as a distinct disease until about the end of the fifteenth century, and typhoid fever, which prevails as an endemic disease in all parts of the civilized world, was not differentiated from typhus until the early part of the present century. There is, therefore, considerable confusion as regards the real nature of the disease in many of the epidemics which occurred in Europe during the middle ages, and even as late as the last century. But there can be no doubt that bubonic plague was one of the chief causes of mortality. It continued to prevail in various parts of Europe during the sixteenth century, and during two thirds of the seventeenth; but during the latter part of the seventeenth century it became more and more rare, and after the middle of the eighteenth century its only

permanent habitat in Europe appears to have been a limited area in the southeastern portion, from which it occasionally spread northward, without, however, extending much beyond the limits of the Balkan peninsula. During the early part of the present century it still occurred to some extent in this region, where it prevailed as an epidemic for the last time in 1841.

Typhus fever, like smallpox, is a disease which is transmitted by personal contagion, and its dissemination depends upon human intercourse. It prevails chiefly in temperate or cold regions, and is unknown in the tropics except at considerable elevations above the sea level. In temperate regions its season of greatest prevalence is the winter and spring. There is no reason to suppose that the specific germ, which has not yet been demonstrated, is able to multiply external to the bodies of infected individuals, and, consequently, conditions relating to soil, moisture, temperature, and organic decomposition are apparently without influence in the development of the disease, except in so far as they affect the predisposition of those exposed to infection. Insanitary surroundings no doubt constitute a predisposing cause by lowering the vital resisting power of those exposed to such influences. But of all the predisposing causes war and famine are shown by the history of past epidemics to have been the most potent.

The earliest reliable accounts of epidemics of this disease date from the eleventh century, but it was not until the sixteenth century that well-recorded accounts of the epidemic prevalence of the disease were made, in the first instance by Italian physicians. The disease prevailed extensively in Italy during the years 1505 to 1530. In the seventeenth century numerous fatal epidemics occurred in various parts of Europe, the disease for the most part following in the track of contending armies, and adding to the scourge of war with its devastations and the resulting scarcity of food the disastrous effects of a deadly pestilence. During the eighteenth century the disease continued to prevail in Europe, and three notable epidemics occurred in Ireland: the first in 1708 to 1710, the second from 1718 to 1721, the third from 1728 to 1731. The last two epidemics, although most destructive of life in the famine-stricken districts of Ireland, also extended to a considerable portion of England and Scotland. In 1734 to 1744 typhus prevailed extensively in eastern and central Europe; it again obtained wide prevalence in 1757 to 1775, a period of wars and famine, and during the last ten years of the eighteenth and the early part of the present century, the period of the Napoleonic wars, it again ravaged the countries over which the contesting armies passed. Ireland appears to be one of the endemic foci of this disease, and when it has invaded

England or Scotland its origin has usually been traced to the "Emerald Isle," where frequent epidemics have occurred during the present century; that of 1826 to 1828 attained considerable proportions, and that of 1846 to 1847 was the most severe of the present century. The number of cases in the last-mentioned epidemic in Ireland is estimated to have been over a million, or about one in seven of the population.

Typhus has prevailed at various times in Mexico, Peru, and Chili, as a result of importation from Spain, since the year 1570, when it first appeared in Mexico. Its first introduction into the United States was at a much later date, and corresponds with the period of extensive emigration from Ireland to the United States and Canada during the present century. For the most part the disease has been confined to the emigrants themselves, or to their immediate attendants on board ship, at quarantine stations, or in the isolation hospitals to which the sick have been transferred. Although the disease has very frequently been brought to our seaport cities, it has rarely extended to the resident population of these towns, and is unknown in the interior of the country. In New York the disease spread to some extent in 1818, 1827, 1837, and 1847, and in Philadelphia a considerable epidemic occurred in 1836, and again in 1862 to 1864.

The conditions governing the epidemic prevalence of *relapsing fever* are very similar to those mentioned in connection with the ætiology of typhus. It is especially liable to prevail during times of scarcity of food, and indeed epidemics are very frequently coincident as to time and place with those of typhus. It is, no doubt, transmitted by personal contagion, and its prevalence is therefore largely influenced by circumstances relating to the susceptibility of individuals, their sanitary surroundings, and their aggregation in ill-ventilated apartments. It attacks more especially those individuals in infected districts who occupy the densely populated and filthy portions of towns and cities, and, as stated by Engel, is peculiarly a *morbus pauperum*, or disease of the poor. On the other hand, it is quite independent of climatic influences, and, so far as we know, has no definite local habitat. The specific germ of this disease was discovered by the German physician Obermeier in 1873. It is a slender spiral filament, endowed with very active movements, and is found in the blood of relapsing-fever patients during the primary febrile paroxysm and also during the subsequent relapses which are characteristic of the disease.

It is impossible to say when or where relapsing fever had its origin, but our first reliable accounts of the disease date from the early part of the eighteenth century, when it prevailed as an epi-

demic in Ireland and in Scotland. Subsequent epidemics have occurred in these countries on numerous occasions. The last epidemic period in the British Isles was from 1868 to 1873, when it prevailed in several of the larger cities of England as well as in Scotland. Upon the continent of Europe it has prevailed chiefly in Russia and in Germany, and the earliest reliable accounts only date back to the year 1833, when it first appeared at Odessa. In 1863 a widespread epidemic occurred in Russia, and in 1868 it prevailed extensively in Germany. It again prevailed in Germany in 1871 to 1872, and in 1878 to 1879. In North America its prevalence has been limited to a few outbreaks in seaport cities having commercial relations with infected localities in Europe. In 1844 it was brought to Philadelphia by emigrants sailing from Liverpool; in 1847 it was brought in the same way to New York and spread to some extent to neighboring towns; in 1869 it was again imported into Philadelphia, and during the two following years spread to a slight extent in this city and in the State of Pennsylvania.

If we may judge from past experience, the predisposing causes of relapsing fever are not sufficiently active in this country to give rise to a serious epidemic, even if cases of the disease should again be brought to our shores. In Egypt, in India, in China, and in the Oriental countries generally, the conditions favorable for the epidemic prevalence of this disease are more commonly met with, and there is evidence that it exists in some of these countries at the present day and has probably been endemic for a considerable period, especially in India. But it is only recently that the English physicians in India have recognized its presence, it having been confounded for many years with the widely prevalent malarial fevers of the country.

Smallpox, like typhus and relapsing fever, is transmitted by personal contagion, but the susceptibility to this disease is so general, independent of predisposing causes, that in the prevaccination period it had a wide diffusion, not only in the overcrowded tenements of the poor, but also in the dwellings of the rich and even in the palaces of kings. The writings of the distinguished Greek physician Galen, who was born about 130 A. D., indicate that he was acquainted with smallpox, but the origin of the disease is lost in the obscurity of the remote past. According to Hirsch, "the native foci of smallpox may be looked for in India and the countries of central Africa." It still prevails extensively in these countries, where vaccination is only practiced to a limited extent. In the years 1873 and 1874 the mortality from this disease in India is said to have been five hundred thousand. "On European soil the smallpox, up to the beginning of this century, or to the introduction of vaccination, had been one

of the most widely distributed, most frequent, and most destructive of pestilences" (Hirsch).

The disease was introduced to the West Indies and to Mexico at an early date after the discovery of the "western world," and nearly every fresh outbreak during the sixteenth and seventeenth centuries can be traced to importation from Africa by ships engaged in the slave trade. The entire native population, not having previously been exposed to the ravages of this disease, was susceptible to infection, and "it was so disastrous that whole tribes were exterminated by it. . . . The disease reached Mexico for the first time in 1520 with troops from Spain; the number of persons swept off in a short time has been estimated at three millions and a half" (Hirsch). The disease was first introduced into one of our Atlantic seaports about the middle of the seventeenth century, when it prevailed in Boston. Since that date numerous localized epidemics of greater or less extent have occurred in various parts of the United States, but, owing to the early adoption of the practice of vaccination, it has not obtained a wide diffusion among the white population. It has, however, been very destructive to the aboriginal inhabitants of the country.

We must now turn to the second group of infectious diseases, viz., those in which the specific germ may multiply, under favorable conditions as to climate and soil, external to the bodies of infected individuals, and which have consequently a more or less well-defined geographic range.

In the case of typhoid fever and of the malarial fevers, which belong to this group, the geographic range is very extensive, while in cholera, in yellow fever, and beriberi it is more limited, as will be seen when I come to speak of these several diseases. The specific germ of *typhoid fever* is now well known, it having been first observed by the German physician Eberth, and independently by the celebrated German bacteriologist Koch, in the year 1880. Its causal relation to the disease was not established until some years later, but is now generally recognized by pathologists and well-informed physicians. This germ is found in the ulcerated glands of the intestine and consequently in the intestinal contents. The discharges from the bowels of typhoid patients, therefore, contain the germs of the disease, which probably multiply indefinitely if they find their way to shallow wells or streams at a season of the year favorable for such development. At all events, whether active development occurs or not, it is well established that typhoid fever is usually contracted by drinking water contaminated by the discharges of typhoid patients. To discuss the relations of this disease to season, temperature, latitude, local insanitary conditions, etc.,

would require far more space than is available at present. It prevails as an endemic disease in all the inhabited parts of Europe, Asia, and America, and the occurrence of epidemic outbreaks depends largely upon an unusual degree of contamination of the water supply of a community by the discharges of those sick with the disease. It may prevail at any season, but as a rule the autumn months afford more cases than occur at other seasons of the year. It is more prevalent in the temperate zone than in the tropics, but in the Orient it claims many victims in tropical regions, and especially in the densely populated portions of India.

Extended experience gained in this country and in Europe shows that the relation of this disease to local insanitary conditions is very marked, and that the typhoid mortality rate is a good index of the general hygienic conditions of a town or city, especially as regards purity of water supply and efficiency of sewage disposal.

Asiatic cholera is a fatal pestilential disease which has its permanent habitat in India, and which during the present century has repeatedly invaded the countries of Europe, and has even crossed the Atlantic and prevailed as an epidemic in certain portions of the western hemisphere. In India it has, no doubt, prevailed from a remote period, and its chief endemic seat in that country appears to be in lower Bengal. The deaths from cholera in the various provinces of India during the five years from 1871 to 1875 amounted to more than seven hundred and fifty thousand.

As regards its epidemic extension to the countries of Europe, cholera is a disease of the present century. The first great epidemic dates from the year 1817, and the disease did not disappear from European soil until 1823. A second period of prevalence in Europe lasted from 1826 to 1837, a third from 1846 to 1863, a fourth from 1865 to 1875, and the fifth and last from 1892 to the present date. The time at my disposal will not permit me to trace the origin and progress of these epidemics; but the general statement may be made that they had their origin in India, and that the progress of the disease was along routes of travel, showing that its propagation depends upon human intercourse. Since the discovery of the cholera spirillum by Koch, in 1884, the method in which the disease is spread has been established in a most satisfactory manner. We now know that the germs of the disease are found in immense numbers in the intestine of cholera patients, and even in individuals who have been exposed to infection, but who manifest no symptoms of the disease other than a slight diarrhœa. Such persons sow cholera seed with the discharges from their bowels, and under favorable conditions rapid multiplication of the germ occurs outside of the body. Infection usually occurs by the ingestion of water or food contami-

nated by such germs, and it has been shown with a great degree of probability that such contamination frequently results from the transportation of infectious material from the surface of the ground, from shallow pits, etc., by flies, which after visiting the most filthy places, may alight upon a beefsteak or fall into the milk jug in a well-ordered kitchen. But by far the larger number of cases result from drinking water containing the cholera germ.

The epidemic extension of cholera depends upon climatic conditions to a much greater extent than does that of typhoid fever. It is especially a disease of hot climates, and of the summer months in temperate regions. The disease may be propagated during the winter, even in cold climates, by the occurrence of a series of cases in localities especially favorable for such propagation, and in this case a recrudescence of the epidemic usually occurs during the following summer. In Russia, during the years 1853 to 1855, nearly two hundred and fifty thousand deaths occurred during the months of June, July, August, and September, and less than twenty-five thousand during the remaining months of the year. In 1832 cholera was introduced into Canada by emigrants from Ireland, and spread rapidly in the valley of the St. Lawrence. An independent importation during the same year brought it to New York and to New Orleans, from which points it obtained a tolerably wide diffusion in the United States. In 1835 it appeared for the first time in South America, on the coast of Guiana. North America was again visited by the scourge in 1848, and it continued to prevail in the United States and Mexico for several years, especially in 1849 to 1850. In the West Indies it caused a considerable mortality in the period from 1850 to 1854. During the year 1854 it again became widely prevalent in the United States. In 1865 the West Indies suffered from another severe epidemic, and in the following year the disease again established itself at three widely separated seaports in North America—Halifax, New York, and New Orleans. From the last-mentioned port it extended throughout the Mississippi Valley. During the years 1865 to 1868 the disease also committed great ravages in some of the South American countries not previously visited by it, and especially in Brazil, Paraguay, Uruguay, and the Argentine Republic. In 1873 cholera was again imported to New Orleans and spread throughout a considerable portion of the Mississippi Valley. Our exemption from an epidemic during the recent widespread prevalence of the disease in Europe is, no doubt, due to the efficient methods for its exclusion adopted at our ports of entry, and especially at New York, where several cholera-infected ships arrived during the height of the Hamburg epidemic of 1892.

Yellow fever is essentially a disease of the littoral, and especially

of seaport cities in tropical and semitropical regions, but in these regions its prevalence is greatly restricted. In North America, although it has occasionally prevailed as an epidemic in every one of our seaport cities as far north as Boston, and in the Mississippi Valley as far north as St. Louis, it has not established itself as an endemic disease within the limits of the United States. In South America it has prevailed as an epidemic at all of the seaports on the Gulf, and on the Atlantic coast as far south as Montevideo and Buenos Ayres; also at several seaports of Mexico and Peru on the Pacific. At present the principal endemic foci of the disease are Havana, Vera Cruz, and Rio Janeiro. In Africa the disease is limited to the west coast, and so far as we know no epidemics have prevailed in the interior of tropical Africa, although the conditions would appear to be favorable for the development of an epidemic in case the disease should be introduced. The same is true as regards the populous regions in northern Africa and southern Asia where the rainfall is sufficient. The disease does not prevail in arid regions, or at considerable elevations above the sea level.

Yellow fever does not prevail as an endemic disease in places which have a mean winter temperature much below 65° F. (18.3° C.), and as a rule epidemics are not developed at a lower temperature than 75° to 80° F. (23.8° to 26.6° C.). The approach of cool weather checks the progress of an epidemic, and in those endemic foci of the disease (Havana, Rio de Janeiro, Vera Cruz) where it prevails annually it is essentially a disease of the summer months. That moisture is an essential factor is indicated by the fact that the disease does not prevail in arid regions where other conditions appear to be favorable, and that it is especially a disease of the seacoast and of the margins of great rivers. Heavy rains, however, exercise a favorable influence in checking an epidemic—probably by cleansing the streets, sewers, etc., in an infected locality. In the tropics the commencement of the rainy season often puts an end to the prevailing epidemic.

Decomposing matter of animal origin appears to form a favorable nidus for the development of the hypothetical yellow-fever germ. It is a disease of towns and cities, and especially of such as are in an insanitary condition. The writer's studies have led him to the conclusion that the infectious agent, as in cholera and in typhoid fever, is probably present in the discharges of the sick.

The early history of yellow fever is involved in obscurity, and it is doubtful whether we will ever be able to settle in a definite manner the disputed question as to its origin. Two principal theories have been advanced: one that it was endemic at certain points on the shores of the Gulf of Mexico at the time of the discovery of the New

World; the other that it was imported to the West Indies from the African coast, probably by vessels engaged in the slave trade, soon after the occupation of the country by the Spaniards. It seems necessary to look for an original endemic focus of the disease elsewhere than in the West Indies, for the reason that, in the few places where it is now endemic, there is historical evidence to show that the disease was originally imported, and that prior to such importation it was unknown.

In Brazil, according to the best medical authorities in that country, yellow fever was not endemic at any of the seaport cities prior to the year 1849. From Brazilian ports the disease has occasionally been introduced to the cities at the mouth of the Rio de la Plata, and has there caused great loss of life.

According to Hinemann, yellow fever was unknown at Vera Cruz prior to the year 1699, a year in which it was widely prevalent in the West Indies. This city is now recognized as one of the endemic foci of the disease, and epidemics at other towns on the Mexican coast have usually been traced to importation from Vera Cruz. The Gulf coast of South America, and especially the French and English settlements in Guiana, have been frequently visited by epidemics of yellow fever. In Venezuela the disease has occasionally prevailed at Caracas and at the neighboring seaport, La Guayra. In Central America epidemics have occurred at all the principal seaports. Upon the Pacific coast of South America the disease was imported to Callao in 1854, and extended from this port to the Peruvian capital and to the principal towns on or near the seacoast. It continued to prevail to some extent until 1869.

The history of yellow fever in the United States shows that the disease is an exotic which has not found the conditions favorable for its continued development at any of our seaport cities. It is true that for many years it prevailed almost annually at New Orleans, but since efficient quarantine regulations have been enforced the disease has been excluded, and no epidemic has occurred in this city since 1878, a period of eighteen years, until the present year. The epidemics in this city attended with the largest mortality occurred in 1819 (mortality, 2,190), in 1847 (2,259), 1853 (7,970), 1854 (2,423), 1855 (2,670), 1858 (3,889), 1867 (3,093).

At Galveston, Mobile, and Pensacola on the Gulf coast, and at Charleston and Savannah on the Atlantic, epidemics were formerly of frequent occurrence, but these cities have also learned to protect themselves by suitable quarantine regulations. The last epidemic occurred in Galveston in 1867 (mortality, 1,150), in Mobile in 1878, in Pensacola in 1882, in Savannah in 1876, in Charleston in 1871.

During the latter part of the eighteenth and the early part of the

present century several severe epidemics of yellow fever occurred in New York and in Philadelphia, and even as far north as Boston. In the great epidemic of 1798 the mortality in Boston was 200; in New York, 2,080; and in Philadelphia, 3,500. The last-named city suffered a series of epidemics about this time—1797 (mortality, 1,300), 1798 (mortality, 3,500), 1799 (mortality, 1,000), 1802 (mortality, 307), 1803 (mortality, 195), 1805 (mortality, 400). The immunity of these cities for many years, notwithstanding their intimate commercial relations with Havana and other infected ports, is in my opinion largely due to sanitary improvements, and especially to the construction of sewers and paving the streets; also to the enforcement of suitable quarantine regulations.

The great epidemics in the United States during the present century occurred in 1853, 1867, 1873, 1878. The epidemic of 1878 was the most disastrous known; 132 towns were invaded, and the mortality was 15,934 (number of cases about 74,000).

In Europe the ravages of yellow fever have been chiefly restricted to Spain and Portugal. This is due to the facts that meteorological conditions are there favorable for the development of the exotic micro-organism to which the disease is due, and that these countries have constant commercial intercourse with infected ports in the West Indies. The first epidemic in Spain occurred in 1700 at Cadiz. This city also suffered in 1730–'31, 1733–'34, 1764, 1780, 1800, 1804, 1810, 1819–'21. The epidemics of 1800, 1810, and 1819 were not limited to the city of Cadiz; the disease extended to the interior, and caused a considerable mortality in the provinces of Granada and Andalusia. In 1878 a limited epidemic occurred for the first time in Madrid. The first Lisbon epidemic was in 1723; the great epidemic in this city was inaugurated in 1856, and reached its acme of development the following year.

Upon the west coast of Africa yellow fever prevails principally along the coast of Sierra Leone. At St. Louis (Senegal) an epidemic occurred in 1778, the first of which we have any knowledge in this vicinity. Frequent epidemics have occurred in Senegambia, and the disease has occasionally prevailed upon the Gold coast, the Congo coast, the Cape Verd Islands, and the Canary Islands. At Nassau in the Bahama Islands yellow fever prevailed as an epidemic in 1861, 1862, 1863, and in 1869.

Another infectious malady which, like yellow fever, has a very restricted endemic prevalence is the disease known as *beriberi*. This prevails chiefly upon the seacoast of Oriental countries, and upon the islands in proximity to these coasts in the Pacific and Indian Oceans. It has been imported to the West Indies and to Brazil, where it prevails to a limited extent in the coast region.

The space at my disposal will not permit me to discuss the ætiology of this disease, but I may say *en passant* that the specific infectious agent, or germ, of the disease has not yet been demonstrated in a satisfactory manner, although claims to its discovery have been made.

My subject is too extensive to be treated in a single paper, and I am unable at present to consider many important infectious diseases of man and of the lower animals. Among these I may mention as especially important the malarial fevers, pulmonary consumption, pneumonia, leprosy, the diseases due to animal parasites of various kinds, those due to parasitic fungi other than the bacteria, contagious ophthalmia, etc. Among the most important infectious diseases of the lower animals, some of which may be transmitted to man by inoculation, are anthrax, glanders, hydrophobia, symptomatic anthrax or "black leg" of cattle, Texas fever of cattle, the surra disease of India, the tsetse-fly disease of Africa, fowl cholera, etc.

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

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XII.—THE ARYAN QUESTION.

IN our school days most of us were brought up to regard Asia as the mother of European peoples. We were told that an ideal race of men swarmed forth from the Himalayan highlands, disseminating culture right and left as they spread through the barbarous West. The primitive language, parent to all of the varieties of speech—Romance, Teutonic, Slavic, Persian, or Hindustanee—spoken by the so-called Caucasian or white race, was called Aryan. By inference this name was shifted to the shoulders of the people themselves, who were known as the Aryan race. In the days when such symmetrical generalizations held sway there was no science of physical anthropology; prehistoric archæology was not yet. Shem, Ham, and Japhet were still the patriarchal founders of the great racial varieties of the genus *Homo*. A new science of philology dazzled the intelligent world by its brilliant discoveries, and its words were law.

We have no time to trace here in detail the revolution of opinion

which the last quarter century has produced. This has been done for us by a master hand.* The logical rottenness of the Asiatic hypothesis, even from the linguistic point of view alone, speedily revealed itself to Latham, Omalius d'Halloy, and others; their contentions were supported by evidences of man's existence in Europe from the remotest antiquity, and of his gradual acquisition of culture on the spot. Then, nearly twenty years ago, arguments based upon the physical characteristics rather than the languages of living European peoples began to be injected into the controversy by Poesche, Penka, and others. Within a decade, physical anthropology dealing with living men, has struggled to its feet and claims the floor—perhaps to the damnation of its predecessors. It may justly be affirmed that no other scientific question, with the exception of the doctrine of evolution, was ever so bitterly discussed, or so confounded at the hands of biased writers by religious and national prejudice.

So much by way of introduction. Let us now at the outset distinguish culture, language, and race; let us rigidly avoid confusing them in any respect. The cultural evidence in turn may be resolved into several distinct parts: arts or customs, language, and perhaps even mythology. Each concerns an entire science by itself. Their relative importance is indicated in the order of naming. The credibility of the testimony of each varies directly with its liability to migrate in entire independence of any actual movement of peoples. Physical traits, of course, are absolutely certain; arts and customs are less apt than is language to be acquired abroad by mere contact. Mythologies are most fluid of all. In this paper we shall deal merely with the first of all these, namely, race, leaving the matter of the origin of culture for future treatment. We shall deal with physical anthropology and the witness of prehistoric archæology alone. Finally, we shall strive conscientiously to distinguish between the positively proved and the merely hypothetical. We shall advance by propositions, keeping them in martial order, as we are entering debatable territory. One great advantage alone we may claim. As Americans, we should be endowed with "the serene impartiality of a mongrel," as the late Professor Huxley put it. No logical conclusion has terror for us. Whether the noble Aryan be

* The best statement of the progress of opinion upon the Aryan question is given by Canon Taylor in the opening chapters of his Origin of the Aryans. Dr. Beddoe, in his Anthropological History of Europe, has succinctly touched upon it also. In our Bibliography of the Anthropology and Ethnology of Europe, soon to appear in a Bulletin of the Boston Public Library, we have collected about a hundred titles of books and monographs on this subject, indexed chronologically. This affords a striking picture of its relative importance in the domain of ethnology. For convenience we shall refer to all papers in this reference list by means of authors and dates alone. Full titles can be obtained by consulting the list.

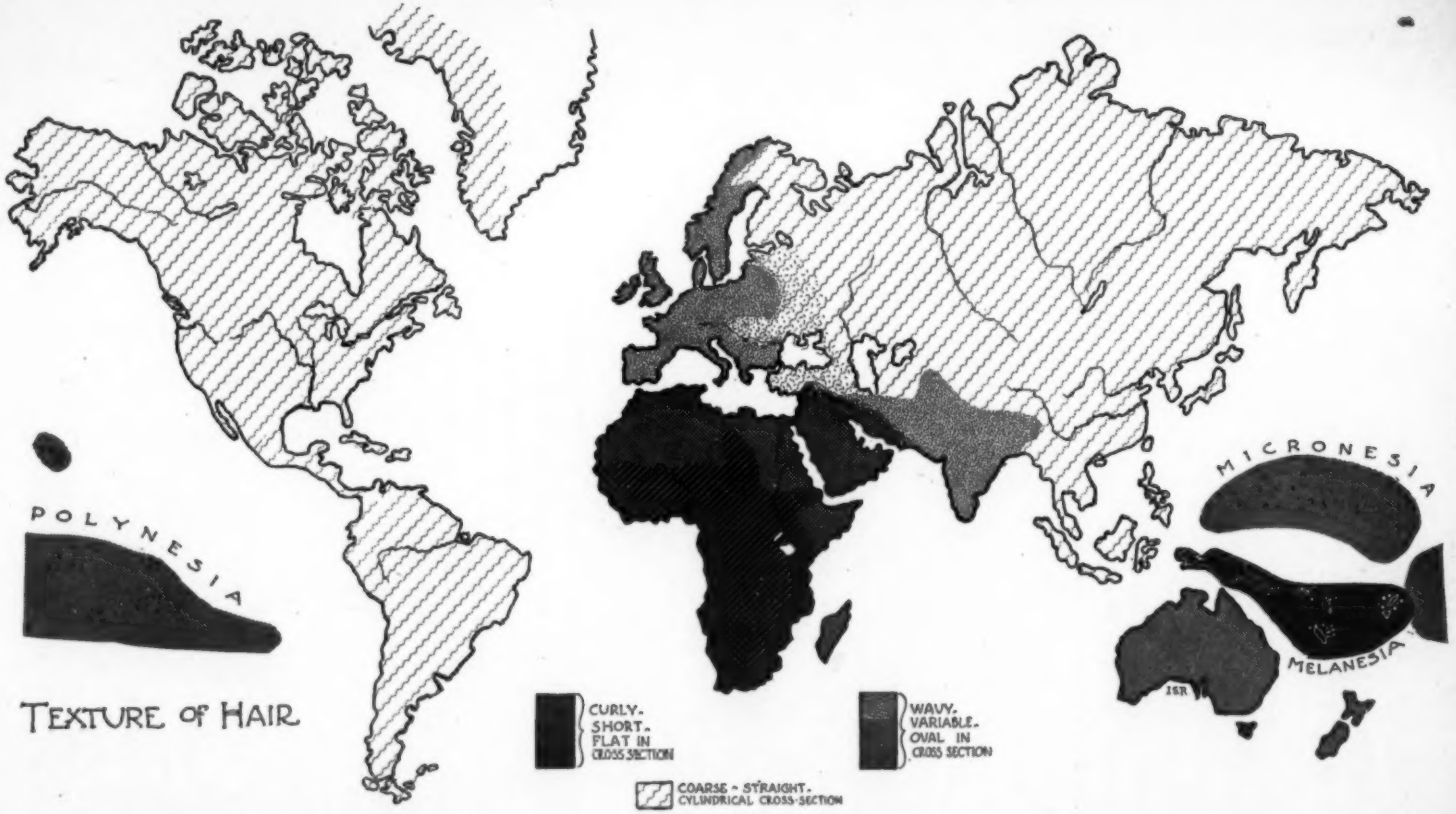
proved Teuton, Celt, or Iberian, it is all the same. We have no monopoly of inheritance in it in any case.

I. *The European races, as a whole, show signs of a secondary or derived origin; certain characteristics, especially the texture of the hair, lead us to class them as intermediate between the extreme primary types of the Asiatic and the negro races respectively.*

From what we have seen of the head form, complexion, and stature of the population of Europe, we might be led to expect that in other physical traits as well this little continent contained all extremes of human variation. We have been surprised, perhaps, at the exceeding diversity of forms occurring within so restricted an area, and in a human group which most of us have perhaps been taught to regard as homogeneous. One physical characteristic alone affords justification for this hypothesis of ethnic homogeneity. This is the form and texture of the hair. Only in this respect, not in color, the hair is quite uniform all over Europe, and even far into Hindustan, where Aryan languages have migrated. At the same time, however, this texture in itself indicates a secondary origin—that is to say, it denotes a human type derived from the crossing of others which we may class as primary. The population of Europe, in other words, should be numbered among the secondary races of the earth. What its constituent elements may have been we shall discuss somewhat later.

The two extremes of hair texture in the human species are the crisp curly variety so familiar to us in the African negro; and the stiff, wiry, straight hair of the Asiatic and the American aborigines. These traits are exceedingly persistent; they persevere oftentimes through generations of ethnic intermixture. It has been shown by Pruner Bey and others that this outward contrast in texture is due to, or at all events coincident with, real morphological differences in structure. The curly hair is almost always of a flattened, ribbon-like form in cross section, as examined microscopically; while, cut squarely across, the straight hair more often inclines to a fully rounded or cylindrical shape. It may be coarse, or fine, or of any color, but the texture remains quite constant in the same individual and the same race. Moreover, this peculiarity in cross section may often be detected in any crossing of these extreme types. The result of such intermixture is to impart a more or less wavy appearance to the hair, and to produce a cross section intermediate between a flattened oval and a circle. Roughly speaking, the more pronounced the flatness, the greater is the tendency toward waviness or curling, and the reverse.

Our map herewith represents the geographical distribution of these several varieties of hair texture among the races of the earth.


POLYNESIA
MICRONESIA
MELANESIA
TEXTURE of HAIR
CURLY.
SHORT.
FLAT IN
CROSS SECTION
WAVY.
VARIABLE.
OVAL IN
CROSS SECTION
COARSE - STRAIGHT.
CYLINDRICAL CROSS-SECTION

As in all our preceding world maps, we have to do with the aboriginal and not the imported peoples. Our data for North America apply to the Indians alone, before the advent of either the whites or negroes. These latter depart in no wise physically from the types whence they were derived. It appears that most of Asia and both the Americas are quite uniformly straight-haired. At the other extreme stands Africa, and especially Papua and the archipelago to the southeast of it, which as far as the Fiji group is known as Melanesia, or the "black islands." This map strikingly corroborates the evidence presented by our other world maps, showing the distribution of the head form and the skin color. Generally speaking, the aphorism holds that the round-headed people are also round-haired. The black-skinned races are, on the other hand, generally long-headed and characterized by hair of an elongated oval in cross section. Physical anthropologists, to be sure, distinguish several subvarieties of this curly hair. Thus, among the Bushmen and Hottentots at the southern tip of Africa, the spirals are so tight that the hair aggregates in little nubbles over the scalp, leaving what were long supposed to be entirely bald spots between. This is known as the peppercorn type, from its resemblance to such grains scattered over the head. And in Melanesia the texture is not quite like that of the main body of the Africans; but for all practical purposes they may all be classed together.

The remaining tints upon our map denote the extension of the wavy textured hair, which is generally intermediate in cross section, varying from ribbonlike to nearly cylindrical shape. There are three separate subdivisions under this head. Two of these, the Polynesian and the Australian, are most certainly wavy-haired mongrels, derived from intermixture of the straight-haired Asiatic races with the extreme frizzled type of Melanesia. This latter is by all authorities regarded as the primitive occupant of the Pacific archipelago, and of Indonesia as well. Among the Malays, and such hybrids as the Japanese, the Asiatic type preponderates; in the Australian peoples the other element is more strongly represented. Tasmania is quite distinct from its neighboring continent. Isolation perhaps has kept it true to its primitive type. The Polynesians and Micronesians seem to be compounded of about equal proportions of each. Of course, all sorts of variations are common. The peoples of the Pacific are peculiarly aberrant in this respect. Some islands are characterized by quite lank and coarse-haired types; some have the frizzled hair stiffened just enough to make it stand on end, producing those surprising shocks familiar to us in our school-geography illustrations of the Fiji islanders.

What shall we say of the European races, the third of our inter-

mediate types? Here also all individual variations occur, seemingly in utter defiance of any law. The Italian is as apt to be straight-haired as the Norwegian; in either nation the curly variety seems to occur sporadically. Yet common observation, to say nothing of microscopical examination, would naturally class the population of Europe among the fine-textured, wavy-haired races of the earth. One never sees the wiry form so familiar in the American Indian, or the frizzle of the full-blooded negro. Are we to infer from this that the people of Europe, therefore, are, like the Polynesians and Australians, the result of an ethnic cross between other more primary types? Certainly the study of the head form, with every extreme known to man within the confines of the single continent, seems to discredit this possibility. The only alternative is to consider this texture of hair to be a more liquid characteristic, so to speak, than the shape of the head; in other words, to assume that a few drops of alien blood might suffice to produce an intermediate texture of the hair, and yet not be adequate to modify the head form. If this were indeed so, then we might imagine that, even while our three European races have kept reasonably distinct in head form, intermixture has nevertheless taken place to some extent in every nook and corner of the continent; and that this infinitesimal crossing has been enough to modify the hair texture. But we are now wandering off into vague hypothesis. There is yet enough that is positively known to demand our attention without indulging in speculation. We have stated the situation; let the reader draw his own conclusions.

II. *The earliest and lowest strata of population in Europe were extremely long-headed; probability points to the living Mediterranean type as most nearly representative of it to-day.*

Of these most primitive races, coexisting with a fauna and flora now extinct or migrated with change of climate from central and western Europe, oftentimes no remains exist except the skulls by which to judge of their ethnic affinities. We know more, in fact, concerning their culture than their physical type in the earlier stone age at least; but it is nevertheless established beyond all question that they were dolichocephalic, and that, too, to a remarkable degree. This feature characterized all subdivisions of the populations of this epoch. Many varieties have been identified by specialists, such as the stocky, short-statured Neanderthal type and the taller and more finely molded Cro-Magnon race. The classification of each nation differs in minor details, but they all agree in this, that the population both of the early and the late stone age was long-headed to an extreme.

The present unanimity of opinion among archæologists concerning this earliest dolichocephalic population is all the more remark-

able because it represents a complete reversal of the earliest theories on the subject. Retzius, in 1842, from a comparison of the Scandinavians with the Lapps and Finns, propounded the hypothesis that the latter broad-headed brunette types were the relics of a pre-Aryan population of Europe. Their comparative barbarism confirmed him in this view. It seemed to be plain that this Mongoloid or Asiatic variety of man had been repressed to this remote northern region by an immigrant blond, long-headed race from the southwest. Nilsson adopted this view; it was stoutly maintained by Pruner Bey in France, and most leading authorities of the day. Then began the discoveries of abundant prehistoric remains all over Europe, particularly in France. These with one accord tended to show that the European aborigines of the stone age were not Mongoloid like the Lapps after all, but the exact opposite. In every detail they resembled rather the dolichocephalic negroes of Africa. The only other races approaching them in long-headedness are either the Eskimos, whom Boyd Dawkins believes to be a relic of this early European people, or else the Australians. Mr. Huxley long ago asserted these savages in turn to be our human progenitors. We need not stop to discuss either of these radical opinions. It is sufficient for us that Broca finally dealt the death blow to the older view in 1868 by the evidence from the caves of Périgord, the very district where our living Cro-Magnon type still survives, as we have already shown.

This dolichocephalic substratum has been traced all over Europe with much detail in the neolithic or late stone age, by which time the geography and the flora and fauna of the continent had assumed in great measure their present conditions. We know that the long-headed races, now found living on the northern and southern outskirts of Europe, in Spain, southern Italy, the British Isles, and Scandinavia, once occupied territory close up to the foot of the high Alps on every side. Remains of it have not yet been found in the mountains themselves, although closely hedging them in on every side. For example, Zampa,* Nicolucci,† and Sergi ‡ have alike collected evidence to prove that the whole basin of the Po River, now a strongly brachycephalic center, was in the nelithic period populated by this long-headed type. In other words, Italy, from end to end, was once uniform anthropologically. For France, a recent summary of the human remains of the late stone age, based upon nearly seven hundred skeletons or skulls, shows an overwhelming preponderance of this long-headed type.* The roundheads were almost entirely absent in the beginning, as in our last article we showed them to have been

* 1891, pp. 77 *seq.*; also 1891, p. 175.
† 1888, pp. 2 *seq.*
‡ 1883, pp. 118 *seq.*
* Salmon, 1895.

in the British Isles during the same epoch. France was apparently very unevenly populated. In all the uplands, especially the central plateau of Auvergne and in the Alps, human remains are less abundant, although when occurring being of the same decidedly long-headed type—this, be it remembered, in those sterile uplands where to-day, as we have shown, one of the roundest-headed populations in the world resides. Less easy to summarize is the evidence from Germany, but the scattered investigations all point the same way.* As for Spain, northern Africa, and Scandinavia,† the earliest types seem to have always been identical in head form with the ones there living to-day, decidedly dolichocephalic. Nor is there in Russia any contradiction of this law, as Bogdanov has shown.

Assuming it as proved, therefore, that the head form of the first population of Europe was of this quite uniform type, what do we know of its other physical characteristics? This concerns the second half of our primary proposition. That is to say, may we decide to which branch of the living long-headed race it belonged; that of the tall, blond Teuton or of the shorter-statured, dark-complexioned Mediterranean type? It is a matter of no small moment to settle this if possible. Unfortunately, we can prove nothing directly concerning the complexion, for of course all traces of hair have long since disappeared from the graves of this early period. Presumptively, the type was rather brunette than blond, for in the dark color of hair and eye it would approach the foundation tints of all the rest of the human race. The light hair and blue eye of northern Europe are nowhere found in any appreciable proportion elsewhere, save perhaps among the Ainos in Japan, an insignificant people, too few in numbers and too remote to affect the generalization. If, therefore, as all consistent students of natural history hold to-day, the human races have evolved in the past from some common root type, this predominant dark color must be regarded as the more primitive. It is not permissible for an instant to suppose that ninety-nine per cent of the human species has varied from a blond ancestry, while the flaxen-haired Teutonic type alone has remained true to its primitive characteristics.

We are strengthened in this assumption that the earliest Europeans were not only long-headed, but also dark-complexioned, by various points in our inquiry thus far. We have proved the prehistoric antiquity of the living Cro-Magnon type in southwestern France, and we saw that among these peasants the prevalence of black hair and eyes is very striking. And again in our last article,

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* Ecker, 1865, p. 79, said mixed; but von Hölder, 1876, p. 20, found purer; Virchow, 1872, p. 191.

† Jacques, 1888, p. 221; Arbo, 1887, etc.

comparing types in the British Isles, we saw that everything tended to show that the brunette populations of Wales, Ireland, and Scotland constituted the most primitive stratum of population in Britain.

As to stature, a trait in which the Teuton and the Iberian differ markedly from one another to-day, we have abundant evidence that this neolithic population was more akin to the medium-statured French than to the relatively gigantic Germans and Scandinavians. The men of this epoch were not, to be sure, as diminutive as the modern south Italians or the Spaniards; they seem rather to approximate the medium height of the inhabitants of northern Africa. These Berbers and their fellows, in fact, shading off as they do into the negro race south of the Sahara, we must regard as having least departed from the aboriginal European type. And in Europe proper the brunette long-headed Mediterranean race is but slightly aberrant from it. It may have become stunted by too protracted civilization, it may have changed somewhat in facial proportions, but on the whole it has remained true to its ancestral image.

III. *It is highly probable that the Teutonic race of northern Europe is merely a variety of this primitive long-headed type of the stone age, both its distinctive blondness and its remarkable stature having been acquired in the relative isolation of Scandinavia through the modifying influences of environment and of natural selection.*

This theory of a relationship between the two long-headed races of Europe is not entirely novel. Canon Taylor hints it under his breath as a remote possibility. We affirm it as the best working hypothesis possible in the light of recent investigations. It will be seen at once that this theorem rests upon the assumption that the head form is a decidedly more permanent racial characteristic than pigmentation. In so doing it relegates to a secondary position the color of the hair and eyes, which so eminent an anthropologist as Huxley has made the basis of his whole scheme of classification of European peoples. Dr. Brinton, and after him Keane, have likewise relied upon these traits in tracing their Aryan race to a lair in northern Africa. Nevertheless, we do not hesitate to affirm that the research of the last ten years has turned the scales in favor of the cranium, if properly studied, as the most reliable test of race. We know that brunetteness varies with age in the same individual—that is one proof of its impermanence. In a preceding article * we devoted some attention to proving also that there is a factor of the environment in mountainous or infertile regions which operates to increase the proportion of blond traits among men. We did not seek

* Popular Science Monthly, vol. l, 1897, pp. 772–780; consult also Buchan, cited by Beddoe, 1893, p. 10.

to determine whether this were due to climate alone, or to the defective nutrition which too often attends a poverty of environment. It is a well-recognized law in the geographical distribution of lower forms of life that two hundred and fifty feet increase in altitude is equivalent to one degree's remove in latitude from the equator. If this be true, applied to man, it would lead us to expect a steady increase of blondness toward the north of Europe, a fact which all our maps have substantiated fully. Experience in colonizing Africa to-day indicates that such adaptation of the Teutonic race to a northern climate constitutes a serious bar to its re-entry into the equatorial regions.* May not this change physiologically be correlated in some way with the modified pigmentation? We should assume, in other words, that as the primitive long-headed type of the stone age gradually spread over northern Europe, environmental influences slowly, very slowly, through scores of generations, would lead this subvariety to emerge. Its differentiation would then be commensurate with the distance from its original southern center of migration—whether a direct product of environment or merely indirectly through natural selection is not for us to determine as yet.

Climate as an explanation for the derived blondness of the Teutonic race is, however, not sufficient by itself to account for the phenomenon. It neglects a significant fact on which we laid emphasis in an earlier chapter, viz., that blondness not only decreases as we proceed southward from Scandinavia, but in an easterly direction as well. In other words, the Russians at the latitude of Norway and Sweden are far more brunette in type. How shall we reconcile this with our environmental hypothesis? In the first place, the hordes which speak the Slavic languages are all comparatively recent immigrants in Europe; they are physically allied to the broad-headed Alpine type. This we shall explain in a succeeding paragraph. For this reason, comparisons between Scandinavia and the lands directly east of it are vitiated at once. But there is yet another reason why we may expect these Teutons to be notable even in their own latitude by reason of their blondness. It is this; that the trait has for some reason become so distinctive of a dominant race all over Europe that it has been rendered susceptible to the influence of artificial selection. Thus a powerful agent is allied to climate to exaggerate what may once have been an insignificant trait. Were there space we might adduce abundant evidence to prove that the upper classes in France, Germany, Austria, and the British Isles are distinctly lighter in hair and eyes than the peasantry.† The classical

* Popular Science Monthly, vol. xlviii, 1896, p. 785.

† Von Hölder, 1876, p. 15; Beddoe, 1870, p. 177, and 1885, p. 187, comparing different classes in Cork, Ireland; Taylor, 1889, p. 244.

Latin writers abound in testimony to this effect. We know also that the Teutonic conquerors of prehistoric times, the Reihengräber, for example, were of this type. Both tall stature and blondness together constitute insignia of noble descent. Gummere has collected some interesting materials from mediæval literature on this point.* The thrall or churl is invariably a dark type, the opposite of the flaxen-haired, blue-eyed jarl or earl. Let us suppose, then, that such an opinion concerning nobility became widespread; suppose that it were intensified by the splendid military and political expansion of the Teutons in historic times all over the continent; suppose it to have become the priceless heritage of people more or less isolated in a corner of Europe! Is there any doubt that, entirely apart from any natural choice exerted by the physical environment, an artificial selective process would have been engendered, which in time would become mighty in its results? Is it not permissible to ascribe in some measure both the patent blondness of this Teutonic race and its unique stature as well to this cause? This is our hypothesis at all events.

IV. *It is certain that, subsequent to the partial occupation of Europe by a dolichocephalic Africanoid type in the stone age, an invasion by a round-headed race of decidedly Asiatic affinities took place. This intrusive people is most nearly represented to-day by the Alpine or Celtic type of central Europe.*

We know that the broad-headed layer of population was not contemporary with the earliest stratum we have described above, because its remains are often found directly superposed upon it geologically. From all over western Europe comes testimony to this effect. We saw in our last article how clear the distinction was in Britain. France and northern Italy give us the clearest proof of it. Oftentimes where several layers of human remains are found in caves or other burial places, the long-headed type is quite unmixed in the lowest stratum; gradually the other type becomes more frequent, until all across central Europe it outnumbers its predecessor utterly. The intensity of this supersession becomes more marked in proportion as we approach the Alps, the present stronghold of the Alpine broad-headed race. Here, however, in the mountains themselves, as we have already said, no displacement of an earlier population seems to have been necessary; for from Switzerland, Auvergne in south central France, and the German Alps eastward, the inhospitable highlands seem to have been but sparsely if at all occupied by the earlier long-headed races. At all events, it is certain that in these restricted areas the broad-headed type is the most primitive. There

* Germanic Origins, pp. 62 *seq.*

it has remained in relative purity ever since. From the earliest remains of the lake dwellers; before iron was used; before many of the simpler arts of agriculture or domestication of animals were developed; man has in these Alps remained perfectly true to his ancestral type.* We can add art after art to his culture, but we can not till very recent times detect any movement of population after the first occupation in a state of relative savagery by this broad-headed race.† It is a surprising instance of persistence of ethnic types.

Let us trace the extension of this invasion of the Alpine race into Europe. Its limits were once much broader than they are to-day. Evidence accumulates to show that it spread widely at first, but that it was afterward obliged to recede from its first extravagant claims to possess all Europe. In our last article we saw that all along the southwest coast of Norway clear evidence of intermixture with this broad-headed type appears. The peasantry show a distinct tendency in this direction. In Denmark the same thing is true; the people are not as pure Teutons as in Hanover.‡ We also know that this race invaded Britain for a time, but was exterminated or absorbed before reaching Ireland. A very peculiar colony of these Alpine invaders seems also to have so firmly intrenched itself in the Netherlands that its influence is apparent even to this day. As we have not described the population of this interesting country in any of our papers heretofore, it will repay us to consider it for a moment.*

Attention was first directed to the Netherlands in 1876 through a remarkable paper by Virchow, in which he analyzed a series of skulls from Friesland and from the islands of Urk and Marken in the Zuider Zee. In this he declared that the long-headed people there resident were not Teutons at all; but by reason of the peculiar low-vaulted formation of the cranium were to be regarded as far more ancient types. He asserted that here in these unattractive lowlands and islands was a last relic of the Neanderthal race of the early

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* Studer and Bannwarth, p. 14; Rütimeyer and His, pp. 41 *seq.*; Zuckerhandl, 1883; Matiegka, 1890.

† Keller's Reports on the Lake Dwellers prove this advance in culture *in situ*.

‡ Virchow, 1870, pp. 63 *seq.*

* The standard authorities on Holland are Drs. A. and J. Sasse, of Zaandam, and Dr. J. C. De Man, of Middelburg, in Zeeland. A full list of their papers will be found in our Bibliography previously mentioned. To the last two I am deeply indebted for assistance in collecting material, which I shall publish more fully later. Our map is based upon Dr. Sasse's data in Tijdschrift Aardrijkskundig Genootschap, Amsterdam, 1879, pp. 323 *seq.*, supplemented by his later work and that of Dr. De Man. For other authorities, consult our Bibliography under Lubach, 1863; von Hölder, 1880; Folmer; and especially Virchow's Beiträge zur Anthropologie der Deutschen, mit besondere Berücksichtigung der Friesen, Berlin, 1876.

stone age. This was stoutly contested not only by the Dutch, but by so eminent German authorities as Von Hölder and others. The research stimulated by the discussion has, I think, controverted Virchow's hypothesis entirely. It is now generally recognized that the majority of these Dutch are Teutonic by descent, not distinguishable from either the Flemish in Belgium or the Germans in Hanover.

The population of Zeeland, with parts of the provinces of North and South Holland and Utrecht, however, including the low islands

Data for this map are corrected from the original skull measurements by adding two units, to make them comparable with other maps based upon study of living heads.

at the deltas of the Rhine, Meuse, and Scheldt, is quite different. Even here, all along the seacoast, the Teutonic characteristics seem to have persisted, probably due to roving bands from the north

similar to those which have settled all along the *litus Saxonicum* in France. But on the inner islands, especially in Nord and Zuid Beveland, there is every indication of a broad-headed Alpine colony of considerable size. This is shown by the dark tints upon our map. An extreme brachycephaly has been proved here by Dr. De Man, who has most courteously sent me photographs of crania reproduced herewith. The long-headed one is from the seacoast, where Teutonic

BRACHYCEPHALIC TYPE. Zuid Beveland. Cephalic Index, 87.

DOLICHOCEPHALIC TYPE. Coast of Zeeland. Cephalic Index, 73.

characteristics prevail; the other globular one is from a village in the middle of the brachycephalic area, submerged in the sixteenth century. These are each typical; the contrast is too marked to need further comment. There can be no longer any doubt that in these islands a settlement of the Alpine invaders took place at an early time. Lubach nearly forty years ago, long before any precise measurements were taken, commented upon the brunetteness, the stocky build, and the round visage of the peasants of this district. In each of these respects they differed from the Frieslanders further north; who, as we have said, are Teutonic by descent. The nearest blood relatives of these south Hollanders are the Walloons in Belgium and the original broad-headed element in the Danish population. From which of these colonies the round-barrow type invading the British Isles came we may never determine; we only know that the Alpine race touched the western ocean at this spot, and has here persisted in remarkable purity to this day. It seems as if a race had here found refuge in this secluded spot against the aggression of the Teutonic type, just as the Walloons are sheltered in the wooded uplands of the Ardennes plateau in Belgium a little farther south.

To resume once more the thread of our argument after this digression, we may continue to trace the uttermost limits of this broad-headed infiltration into Europe. The whole basin of northern France was overflowed, and the incoming human tide from the east

swept away out to the point of Brittany, where it has held its own to this day. The central plateau of France, in fact, was peopled by it, perhaps for the first time.* The intrusive type seems also to have with difficulty entered Spain, for, as we have shown, the population of the mountainous northwest provinces is even at this present day less purely Iberian in type by reason of it.† One spot alone south of the Mediterranean Sea was perceptibly affected by it; recent evidence from the island of Gerba off Tunis proving such colonization to have taken place.‡ In Italy we are certain as to the extension of the Alpine type down into the peninsula. The existing population of the Po basin was submerged entirely, with the inherited result that the broad-headedness of the peasantry to-day becomes less frequent across Tuscany until it vanishes somewhat north of Rome.* In the eastern half of Europe the occupation was complete; whether primary or not it is impossible to state. In Austria at least, a long-headed people probably antedated it.‖ We only know that the broad-headed Slavic populations extend to-day uninterruptedly across from the Baltic to the Black Sea, apparently becoming purer as we proceed eastward.

What right have we for the assertion that this infiltration of population from the east—it was not a conquest, everything points to it as a gradual peaceful immigration, often merely the settlement of unoccupied territory—marks the advent of an overflow from the direction of Asia? The proof of this rests largely upon our knowledge of the people of that continent, especially of the Pamir region, the western Himalayan highlands. Curiously enough, just here on the "roof of the world," where Max Müller and the early philologists placed the primitive home of Aryan civilization, a human type prevails which tallies almost exactly with our ideal Alpine or Celtic European race. The researches of de Ujfalvy,△ Topinard, and others localize its peculiar traits over a vast territory hereabouts. The Galchas, Tadjiks, and their fellows are gray-eyed, dark-haired, stocky in build, with cephalic indexes ranging above 86 for the most part. Be it noted, these people are not Hindus, those whom Max Müller held to be modern representatives of our primitive common ancestor. The Hindus are rather akin to our long-headed Mediterranean race. The basin of the Ganges is as different anthropologically from the Himalayan highlands as that of the Rhône is from the Swiss or Italian Alps. This was emphasized in our world

* Salmon, 1895, and Hervé, 1896, have well summarized the evidence for France.

† Hoyos Sainz and Aranzadi, 1892, and Jacques, 1888. ‡ Bertholon, 1897.

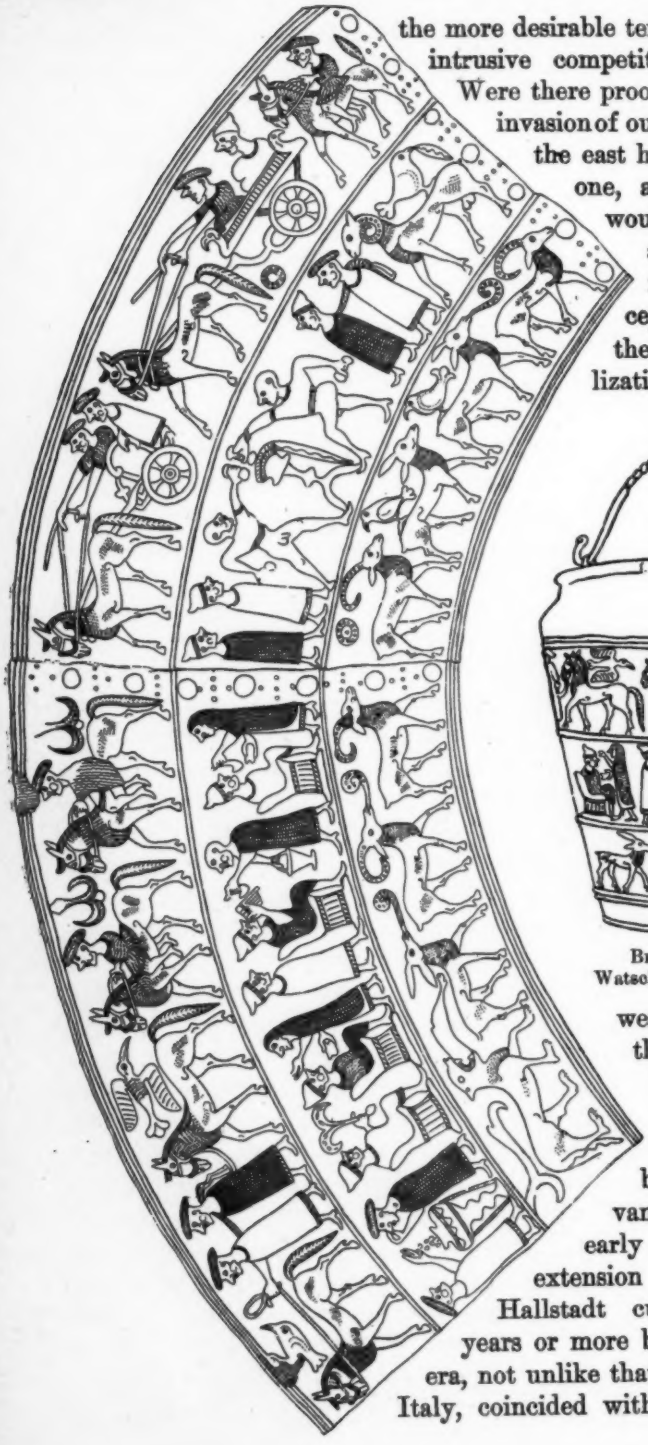
* Zampa, 1891, is best on this. ‖ Matiegka, 1890.

△ Les Aryens au Nord et au Sud de l'Hindou-Kouch, Paris, 1896. For other peoples of India, consult Risley.

map of cephalic index published in the March number of our series. Thus do we discover the complexity of the problem. Even if the old philologists were right in tracing European languages to a primitive home in western Asia, a point which is generally denied to-day, there would still be no possible solution as to which of these two Asiatic types were entitled to the name Aryan. Probably the Hindu would have been adopted for this honor; he is kith and kin physically of the Mediterranean race to which the Semites, Greeks, and Romans belong. But how about our proof that this type is the most primitive in Europe, persisting *in situ* from the stone age! Whence came the Aryan civilization then? The question is too broad to be settled here and now. We may return to it later.

The only point which the discovery of a broad area in western Asia occupied by an ideal Alpine type settles, is that it emphasizes the affinities of this peculiar race. It is no proof of direct immigration from Asia at all. It does, however, lead us to turn our eyes eastward when we seek for the origin of the broad-headed type. The wedge-shaped area of present Alpine occupation in Europe vaguely points to an original ethnic base of supplies somewhere in this direction. It could not lie westward, for everywhere along the Atlantic the race slowly disappears, so to speak. Neither does its original source lie in central Europe, for its greatest representation lies in the Slavic countries east of Vienna and Berlin. That the Alpine type approaches all the other human millions on the Asiatic continent, in the head form especially, but in hair color and stature as well, also prejudices us in the matter, just as the increasing long-headedness and extreme brunetteness of our Mediterranean race led us previously to derive it from some type parent to that of the African negro. These points are then fixed: the roots of the Alpine race run eastward; those of the Mediterranean type toward the south.

Before we leave this question we must clear up a peculiar difficulty. If the Alpine broad-headed race entered western Europe with sufficient momentum to carry it clear across to the British Isles, up into Norway, down into Spain, intruding between and finally separating the more primitive long-headed population into two distinct groups, why is it everywhere to-day so relegated to the mountainous and infertile areas? This is especially true wherever it comes in contact with the Teutonic race in the north. It is one of the most striking results of our entire inquiry thus far, this localization of the Alpine type in what we have termed areas of isolation. One is at a loss to account for this apparent turning back of a tide of prehistoric immigration. The Teutonic race must once have yielded ground before the invader; our prehistoric stratification shows it. Why has it now turned the tables and reoccupied all



the more desirable territory, driving its intrusive competitor to the wall? Were there proof that the original invasion of our Alpine race from the east had been a forcible one, an answer to this would be afforded by a study of culture; for it is now accepted generally that the main arts of civilization have entered

BRONZE SITULA.
Watsch, Austrian Tyrol.

western Europe from the east. Moreover, the present seat of the Alpine race was characterized by a peculiarly advanced civilization in early times. Thus the extension of the so-called Hallstadt culture a thousand years or more before the Christian era, not unlike that of the Etruscan in Italy, coincided with the territory now

distinctly Alpine by race. The character of this culture, its manners and customs, and its skill in the arts, are shown by the accompanying cuts.* This is a reproduction of the design upon a bronze "*situla*" or vessel found at Watsch in the Austrian Tyrol in 1882. A culture capable of such work as this, and possessed of such a civilization to represent, centered in the eastern Alps at a very early time. We are assured, moreover, that the people were overwhelmingly Alpine in racial type. Study of upward of one thousand crania from their graves has made this certain.† At the early period when this culture flourished, Scandinavia and Britain were probably in a far lower stage of civilization. Hence if, as we say, the invasion by the broad-headed race had been by force of arms, every advantage would have been on the side of the more civilized race against the primitive possessors of the soil. The clew to the situation would have lain in the relative order in which culture was acquired by the competing populations. It would then have been possible that the Alpine invaders, penetrating far to the west by reason of their equipment of civilization, would have lost their advantage so soon as their rivals learned from them the practical arts of metallurgy and the like. Unfortunately for this supposition, the movement of population was rather an infiltration than a conquest. How may we explain this?

Our solution of the problem as to the temporary supersession of the primitive population of Europe by an invading race, followed by so active a reassertion of rights as to have now relegated the intruder almost entirely to the upland areas of isolation, is rather economic than military or cultural. It rests upon the fundamental laws which regulate density of population in any given area. Our supposition is this: that the north of Europe, the region peculiar to the Teutonic race to-day, is by nature unfitted to provide sustenance to a large and increasing population. In that prehistoric period when a steady influx of population from the east took place, there was yet room for the primitive inhabitants to yield ground to the invader. A time, however, was bound to come when the natural increase of population would saturate that part of Europe, so to speak. A migration of population toward the south, where Nature offered the possibilities of continued existence, consequently ensued. This may have at times taken a military form. It undoubtedly did in the great Teutonic expansion of historic times. Yet it may also have been a gradual expansion—a drifting or swarming forth, ever trending toward the south. We know that such a migration is now taking place. Germans are pressing into northern France as they have

* Consult our Bibliography for a full list of authorities by von Sacken, Hochstetter, Hoernes, Chantre, and others. Ranke, in Der Mensch, gives a good account of it.

† Zuckerhandl, 1883, pp. 93 *seq.*

always done. Swiss and Austrians are colonizing northern Italy; Danish immigration into Germany is common enough. Wherever we turn we discover a constantly increasing population seeking an outlet southward. The ethnic result has been therefore this: that to-day the Teuton overlies the Alpine race, while it in turn encroaches upon, submerges the Mediterranean type. Thus do economic laws, viewed in a broader way, come to the support of ethnic facts. Other problems concerning population are immediately suggested. These we shall consider in the next and final paper of our series.

THE KING OF THE WOODS.

By NORMAN ROBINSON.

VERY few persons ever visit the southern portion of the United States and become at all familiar with its woodland life without being captivated by that prince of singers, the mocking bird. Not only as a musician, but in general "smartness," he is far and away ahead of anything else that flies. He is the "Yankee" among birds. In vivacity, in cleverness, in a quick and dexterous use of his small but brilliant brain, it would be hard to point out his equal. And when in the springtime the woods resound with his clear, flute-like, and exultant notes, even the man, if such there be, "who hath no music in his soul" would find it hard to resist the contagious good humor of his glad and gleeful song.

And yet the mocking bird (*Mimus polyglottus*) is incorrectly named. He is by no means a natural mimic. Half a dozen birds could be mentioned that in this particular far surpass him. This may seem a very strange thing to say, in view of the stories current so abundantly illustrating and emphasizing this supposed gift.

Professor Chandler, in a notable case in a Boston court, once remarked that it was practically impossible for most people to tell the truth even if they tried. Especially is this the case in observing scientific phenomena by persons not trained in that special field. Imagination often plays strange tricks with the recording cameras in such excited brains. As an illustration bearing upon the case in point: A lady had a beautiful grove of young oaks in her front yard of several acres in extent. It was fairly alive with mocking birds. It was in the springtime at their first nesting season, and many of the young birds were beginning to try their wings. One morning Jim, the lazy old tomcat, was missed from his accustomed corner on the sunny porch, and soon was heard a chorus of confused and stridulent cries issuing from the back part of the grove, and there came Jim

scampering toward the house, pursued by half a dozen or more of mocking birds. They were darting down upon him and pecking at him from all directions, with special reference to putting out the eyes of the now thoroughly frightened cat, while from their angry little throats all the while was pouring forth a torrent of bird "billingsgate" that could hardly have been excelled by "our army in Flanders." At the dinner table this lady gave a very graphic account of how the tables had been turned on Jim. "But the most singular thing of all," said she, "was that when those mocking birds were pecking away at the eyes of that poor cat, they were all crying 'Scat, scat, scat!'" The mocking bird has an angry note consisting of the syllable "ka-a," with short *a*, sharply and rapidly repeated, and it required no great effort on this lady's part to put an *s* in front of the *k*, especially as there was the cat running for dear life, and the confused cries of his winged pursuers did have a great deal of resemblance to the tones of a woman who has surprised pussy with her head in the cream jug.

The fact is that this southern songster has naturally a very extensive repertoire of sounds, most of them musical, to which he seldom adds a new note, and which he generally arranges in pretty definite order. Among these sounds not a few more or less resemble the songs or cries of our common forest birds. It does not require so very vigorous an imagination to transform what is simply the natural note of the mocking bird into a very fair imitation of his less gifted neighbors. That there is any conscious or intentional mimicry about it, facts go to disprove. An isolated bird will sing his own notes and imitate songs he never heard. So, too, with the mocking bird's supposed imitation of the "miew" of a cat, the cry of a chicken, etc., they are all alike the natural notes of the bird plus a little imagination, which the circumstances supply. In point of fact, the mocking bird is a very dull pupil when you attempt to teach him any new musical sounds or combinations of sounds. Whether it is because he "knows it all" already, or is indifferent to new music, the fact remains. One bird, a beautiful natural singer, received patient teaching at night in an unlighted room for a month before he seemed to be trying in an awkward way to imitate the notes of his instructor. It was very much "mixed," but it was clearly an attempt at his lesson—the first five notes of "Rory O'More." This was encouraging, and showed that an impression had at length been made upon the tiny brain. Efforts were redoubled, and at the end of three months the bird could whistle fairly well the first two bars of the song. Still he not infrequently made mistakes, forgot his small "score," and was by no means a success as a singer of anything but his own natural and inimitable songs.

As a household pet the mocking bird is simply delightful. If taken young and reared in a cage he becomes very tame. He will fly to your knee, eat from your fingers, perch on top of your head, jump down to your shoulder, pull your whiskers, if you have whiskers, give you little love taps on your cheek, and in a hundred cunning ways evince his sociable and friendly disposition. He loves to get out of his cage and fly about the room, and if there are no cats about seldom attempts to fly out of the window. One caution, however, is necessary. A bit of cloth or a thread is a great find for a mocking bird. He will spread out his wings, flirt his tail, cock his eye, twist and turn his quick little head, and shrug his shoulders in a comical pantomime of astonishment. Then he will dart to some desk top or chair round, and the first you know he is swallowing it. A few such experiences are disastrous.

In New York there is one of these wonderfully gifted little pets named Peter. He is just four months from the nest, and was taken from Florida with several others before the stringent laws protecting song birds were promulgated. He has already his Maltese coat and new tail, and is in every respect a precocious bird, not only equaling in song many a full-grown singer, but rivaling the best of them in amusing antics and in genuine intelligence. He takes the end of a piece of thread tied to a spool, jumps over his perch to the floor, and keeps this up till he has wound all of the thread on the perch, and has the spool suspended in the air. Then that game is done. He next takes a corner of the clean white paper that is put into his cage to cover the floor every morning after his bath, and with his beak persistently rolls it up like a carpet, and leaves it at one end of his cage. He opens the latch of his door and walks out whenever he pleases.

Here in Orlando, Florida, the mocking birds are far the most numerous birds. They are now protected by the most stringent laws. To kill, catch, or even keep one in a cage, is an offense punishable by heavy fine and possible imprisonment. In a short space of time the result is that they have multiplied wonderfully, and are just about as tame as chickens. They frequently fly into the kitchen, and have been known sometimes voluntarily to enter a cage in pursuit of food.

One of the most interesting traits of these birds is their fearlessness. In defense of their supposed rights, and especially in protecting their young, they will fight anything from a dog to an elephant. One reason probably why the English sparrow has never obtained much of a foothold in the South is because some mocking-bird congress has passed "bird immigration laws," which positively shut out this pestilent and aggressive European intruder. "Bobwhites,"

blue jays, woodpeckers, shrikes, and the beautiful little mourning doves, the smallest known species, and other varieties less frequently seen—all seemingly have perpetual treaties of peace with the mocking birds. The only one that gets into a "scrap" with the "boss of the forest" is the shrike, a short, chunky little fellow, about the size of the mocking bird, and with a powerful beak with which he delights to impale small animals upon orange thorns. One would suppose that the mocking bird would be in deadly fear of this little feathered bully. Not a bit of it! Other birds may run from the shrike, but he doesn't. Both love to build their nests in the orange trees, and there are frequent questions of "squatter sovereignty" to be settled by beak and claw. Whether by lung power or muscle, in the final "compromise" the shrike always goes to another tree.

As to the morals of this little past master of song, the truth must be told, he has no respect for the eighth commandment. He is a thief, a cunning, inveterate, unscrupulous "conveyer" of other people's property. Peaches, grapes, strawberries, figs, Japan persimmons, Surinam cherries, Catley guavas, are to him legitimate plunder. With the exception of oranges, bananas, pineapples, and ordinary guavas, which he never touches, nothing is safe from his depredations. Scarecrows don't even amuse him when he has made up his mind to sample fruit. He is a capital judge, too, and always selects the largest, ripest, and most juicy specimens for his repast. No economic considerations trouble him either. He takes a bite here and a nibble there, and ruins twenty times as much as he consumes. Bagging fruit is no protection, for he only tears the bags to pieces and helps himself. Even vines and fig trees incased in mosquito netting are not secure; the little marauder will get in somehow and complacently take what he wants.

Yet, in spite of all this, the benefits received by the south land from this cunning little giver of sweet sounds and lover of sweet fruits vastly outweigh all the damage that he does, however vexatious it may be. Bugs and worms and creeping things swarm here the year round. The mocking bird is essentially insectivorous. His "steady diet" consists of the enemies that the horticulturist and the fruit grower have most occasion to dread. He takes his fruit by way of dessert, and has fairly earned it like a good boy by eating first a substantial dinner.

A BERZELIUS museum is to be established by the Swedish Academy of Science, with funds provided by Prof. Hj Sjorgen. It is to hold all the objects formerly contained in the laboratory of the great chemist—which are now scattered in various places. In connection with it a list of all the works and treatises of Berzelius is to be compiled.

SCIENCE AND MORALS.

By P. M. BERTHELOT.

SCIENCE, held under the ban through the long course of the middle ages, has now conquered its independence, by virtue of the services it has rendered to man. It has fulfilled the promises made in its name by the natural philosophers of the seventeenth and eighteenth centuries, and has transformed since then, as it has indeed been doing from the beginning, the material and moral conditions of the lives of the people. The changes accomplished from the beginning of civilization have had a most effective promoter in science, although its real importance was long hidden or obscured by the mixture of elements borrowed from the imagination. For two centuries and a half only has the scientific method been disengaged from all strange alliance, and been manifest in its purity; its efficiency has been attested in the most various ways by a constantly accelerated industrial and social evolution.

There exist, indeed, and always will exist, many deplorable things, much suffering, and much wickedness in the world; but it is to the credit of science that, instead of lulling mortals with the feeling of their powerlessness into the passivity of resignation, it has urged them to react against destiny, and has taught them the sure way by which they can diminish the sum of woe and injustice, and increase their happiness and that of their fellows. It has not accomplished this by means of verbal exhortations or *a priori* reasoning, but by virtue of processes and words really efficacious, because they are acquired from the study of the conditions of existence and the causes of evils.

The words mystery and miracle are alike excluded from scientific language and methods, not by virtue of purely logical deductions, but because wherever it has been possible to take deep soundings of phenomena we have found that they were constantly produced in accordance with a determined relation between effects and causes. It is exactly this *a posteriori* determination that constitutes the scientific method. We do not, indeed, pretend to say the last word concerning the universe. We profess, on the contrary, that that word can not be formulated in advance, and we know that among the infinite variety of phenomena we never succeed in meeting and observing more than the most infinitesimal part. We know the whole extent of our ignorance, and have the modesty consonant with it, but it should not be represented by a universal skepticism; no more should it cause us to depend upon the existence of supernatural verities, and paralyze our efforts to the profit of mysticism. The

scientific method has been recognized, by the experience of ages that have passed as by that of present ages, as the only efficacious method of arriving at knowledge. This is the significance of the exclusion of mystery in the study of man and the universe, and in the government of individuals and societies, which is, or rather ought to be, the consequence of this study. The mystic who assumes to direct his life and business according to the ideas of the marvelous would very soon be lost; general history and mental pathology show that peoples and persons who have adopted mystery and divine inspiration as exclusive guides have been precipitated at once into irreparable moral, mental, and material ruin. We may, then, leave the mystics to enjoy their dreams, but must not permit their intolerance to impose these dreams upon us as the rule of social activity. Man has, indeed, always sought to escape the severity of determinism in this way, just as he formerly tried to impose his will upon the superior powers by the conjurations of magic, or to turn aside the rigor of destiny by incoherent prayers. But such illusions need not make us depart from the rigor of our method of proceeding, or be allowed, by an irrational confusion, to destroy the exactness of our results. This irrevocable separation between the scientific method and mystery has not always been; it is the product of a long elaboration, in which empirical and experimental conceptions have been associated and confounded. For better comprehension, let us try to summarize in general outline the historical evolution of science. In all things we can best comprehend the present by going back to the beginning.

Let us carry ourselves back to those distant periods during which our species was gradually disengaging itself from animality. We can do this to a certain extent by the aid of archæological discoveries, and by comparing them with the stories of travelers who have observed savage tribes which have been arrested at different steps of the evolution that has been accomplished since the primitive ages by civilized peoples. Thorough examination of the habits and instincts of animal species, knowledge of the laws of the psychological and physiological development of the individual, especially in his infancy, unite with history to cast a strong light on the problems with which we are here concerned. The sum of these studies has shown how the human races, each according to its degree of intelligence, have gradually created the instruments, arms, and customs by the aid of which they achieved their first triumphs over Nature and accomplished their first organizations. The family and the state, morality and virtue, gradually issued from the social instincts which we see in action, now, as formerly, among the animal races.

The intelligence of the first men was too feeble, however, to conceive either the abstract laws of their own development or those of

natural phenomena. It personified them; it made realistic beings of them, constructed in its own semblance—that is, souls and gods. Such is, in fact, the universal tendency, as has been established by travelers among savages. Our own children, too, are prompt to transform their joys and their fears into superhuman phantoms. The images of dreams serve them as guides in this respect. In a word, observation shows that men are drawn by a spontaneous inclination to give objectivity to the products of their own thought, in order to create personalities and symbols, to which they shortly assign an absolute character, autonomous and divine. In this way, at the origin of the civilizations, every invention, every organism, was attributed to celestial revelations. The most intelligent and best instructed men founded their domination on such prepossessions, which they shared in, too, and when the temples rose at Memphis and Babylon, all knowledge was concentrated around their altars. The same persons, protected by their sacred character, then represented science and religion. The two orders of ideas were confused into a common dogmatism. A similar condition was reproduced at the beginning of the middle ages, after the destruction of the ancient civilization by the barbarians.

Hence the singular character of these primitive sciences, like astrology and alchemy, in which positive results were associated with the dreams of magic, and in which the efficacy of experimental practices had to be assured by the use of formulas and incantations, intended to control the will of the gods and command their assistance. Miracle was then obligatory upon the divinity, and independent of all moral notions. The Greek philosophers first tried to disengage true science from this alliance and render it purely rational. They, too, were at first accused of impiety—an accusation which has not ceased to be sounded for two thousand years, and which has cost the lives, from Socrates down, of the purest and most disinterested men. Yet, Greek genius, with all its power, never reached a clear apprehension of the scientific method, as we apply it now in the study of the world and of man. That method was not distinctly separated from pure and established logic till the seventeenth and eighteenth centuries, during which period the experimental sciences and the sciences of observation—physics, astronomy, mechanics, chemistry, physiology, and natural history—were definitely constituted. The method has been since extended to the historical and sociological sciences, in place of the old systems—the issue of the theology of the middle ages. We add, finally, that it is only in our own time that the scientific method, which looks to the relative and excludes the absolute, has begun to be fully applied and extended to ideas of every order.

Science presents itself to us under a double aspect: as primitive science, which is the solid basis of every application, in the material as well as in the moral domain; and ideal science, which comprehends our near hopes, our imaginings, and our remote probabilities. The common bond between these two aspects is method. Our method consists in first observing facts. I mean internal facts, revealed by consciousness or inner sensation, as well as external facts, made manifest by outer sensation; and in provoking the development of both by experiment, the principal source of our discoveries. This method is the same for social and political, for material and industrial facts. The study of facts thus constitutes the point of departure for all knowledge. When facts are once established, human intelligence brings them together and seeks to determine general relations between them. Hence, what we call scientific laws; and upon these laws rests all application of science, to individuals as well as to societies.

But this pure determination of facts and their laws does not satisfy the human mind. Drawn by an invincible tendency, it supports itself upon the facts and rises above them to construct representatives or symbols, by the aid of which it collects its knowledge into a co-ordinated system of hypotheses. Such a system is even indispensable if we would go further and make discoveries; for, in order to find new facts and new relations, it is necessary first to imagine them; then we seek for the realization of them. Each one develops as he will, following his individual inspiration according to his feelings and creative faculties, the consequences of the conceptions and symbols by the aid of which he has figured facts and laws to himself. But the student also should always be ready to abandon his hypothetical beliefs as soon as the facts have demonstrated the vanity of them. In any case, every one finally builds up thus his system of the world—a scaffolding, resting at the bottom on facts, but the solidity of which—I mean the certainty, or rather the probability—diminishes as one goes higher.

Thus facts and laws, through symbols and hypotheses invented to co-ordinate them, constitute the fundamental basis and even the sole substratum of every system. Such are to-day the general views, such the manner of proceeding, of those who seek to raise the scientific ideal above empiricism.

The diversity, the profound contrast existing between the scientific and the theological methods employed in the seeking for truth are manifested to a very striking degree in the application of these methods to the government of individuals and of states. While theologians erect their systems regarding the beginnings and the ends of things into absolute and invariable principles revealed by

the divinity of whom they declare themselves *a priori* the organs, and while they assume to impose them, even by force, as the eternal rules of private and social life, men of science, having recognized the relative and historical source of these assertions, limit themselves to applying actual rules to the practical conduct of life, in morals and politics as well as in hygiene and industry—rules always provisional, and subject to modification from day to day by the evolution of future ages, as they have been constantly modified in past ages.

The prime characteristic of modern science is its readiness to declare the increasing uncertainty of its ideal constructions. While it does not refuse to examine problems of origin, while it itself furnishes the only probable data by the aid of which the solution of them can be pursued, it affirms nothing and promises nothing in the matter. It would consider it equally rash to set up on similar constructions the rules of industrial applications and moral rules for the conduct of individuals and societies. In real things we never proceed in the name of absolute principles, because we have learned that all our principles rest upon hypotheses borrowed from the facts of observation under a direct or simulated form. To deduce everything from absolute principles is an illusion. Whatever pretends to be supported on the absolute is supported on nothing.

Man's knowledge is gained solely by the method of the observation of facts, but is derived from two sources, an internal and an external one. Sensation reveals the external world to us, and is the point of departure of all the physical, natural, and historical sciences. It exhibits the insignificance and subordination of the individual in mankind, present and past; the insignificance and subordination of mankind overwhelmed and almost reduced to nothing in the infinite whole of the universe. From this point of view, all morals consist in our humble submission to the necessary laws of the world; religions say nothing more than this when they subordinate the human mind to the divine will. In this domain everything is objective.

In the inner world, that of consciousness, on the contrary, the man appears alone; his mind, his feelings, become the measure of things. These have no existence for us, except on the condition that they are known, and therefore from that point of view they exist only for our intelligence and in our intelligence. In this domain all is subjective. Such is the contrast—I do not say opposition—between the two sources of our knowledge. Now, these two sources, internal and external, of our positive knowledge are equally, I repeat, the two sources of our morals.

Human morality, no more than science, does not recognize a divine origin; it does not proceed from religions. Its rules are drawn from

the internal domain of conscience, and the external domain of observation.

The man of our time finds in the depth of his consciousness the idea of good and evil, and the ineffaceable feeling of duty that is the categorical imperative of Kant. Duty is further conceived as toward himself and toward other men—that is, he comprehends the solidarity of his relations. These are fundamental facts of consciousness, independent of all theological or metaphysical hypothesis. The ideas acquired from the exterior source of our consciousness—that is, from history and the natural sciences—present morality under a different light, in that they show the instinctive origin and the evolution of it. The human species, in fact, only represents a particular case among the multitude of animal species that live in society. With these we witness, according to the degree of perfection they manifest, the appearance of the first elements of morals. The family, offspring of the instincts that preside over the preservation of the species, exists, temporarily at least, among birds and mammals, not to go lower. It coexists with the feeling of maternal love, and in certain cases of paternal love, raised to the highest degree.

With the feeling of the family we meet also, among the social species, that of solidarity and the devotion of the individual to the collective whole, rising sometimes to the sacrifice of his life. The study of the still savage human races has shown how near their special morality lies to that of the social animal species, if it is not even inferior to that of some of them. There are, in this respect, great differences in the social instincts, among men as well as among animals. But the existence of a general basis common to both is demonstrated by observation.

The social instincts, and the feelings and duties derived from them, are not, then, peculiar to the human species, and due to some strange and divine revelation, but are inherent in the cerebral and physiological constitution of man—a constitution similar to that of the animals, but of a superior order, and having become more so during the course of centuries by the effects of the conquests of our intelligence. The hereditary perfection of these instincts is the real basis of morals, and the point of departure for the organization of civilized societies.

As men advanced in civilization, their positive knowledge, continually increasing, demonstrated the social utility of certain duties and certain moral laws, which were rendered obligatory by the chiefs of the states—priests and legislators. But these laws, deduced from scientific notions, were associated and in a manner amalgamated with the arbitrary prescriptions of the theocracy, and proclaimed according to mystic formulas, from which no mind was then free.

The history of the religious formations and evolutions that have succeeded one another among mankind for seven thousand years shows that there exists no genetic bond, no necessary relation, between morals and mysticism. With nations as with individuals, the least moral personalities are often met among the most religious. In short, history proves that the development of morals in the world has been connected at the same time with science, from which it has proceeded; and with religions, which have rested upon it as one of their points of support. But no more from the external point of view of history than from that of internal consciousness have morals been the product of religions. The same representative illusion always appears, which transforms into the generative cause of certain ideas the notions that have issued from them.

The modern conception of morals is of a generous and universal character. It rises with the elevation of intelligence; its practical applications are more or less delicate, according to the sentiments variously developed by peoples and individuals. But it responds to-day, as it has always responded, to the condition of knowledge as it is more or less advanced according to time, places, and persons. Therefore it could not continue fixed in any decalogue. It undergoes gradual modifications with the continual discoveries of the physiological, psychological, and sociological sciences. Just as there exists by the side of positive science an ideal science, derived from it, moreover, but which precedes it and incites it forward, so there are ideal morals, which announce and precede the evolution of future morals. These ideas, this conception of modern morals, are becoming every day more preponderant, and if they have not yet been accredited by men as established science, it is because of the long religious servitude that has been imposed on education. Down to our own time it has been the practice to base the moral education of the people and the rules of conduct on the catechism—on theological doctrines and prescriptions—instead of establishing them upon positive data acquired from consciousness and the historical and natural sciences.

We now see every day how the application of scientific teachings to industry is continually adding to the wealth and prosperity of nations. The application of the same teachings to hygiene and medicine is constantly diminishing the pains and risks of disease, and increasing the mean duration of life. The history of the present century likewise demonstrates to what point the lot of all, including the poorest and most humble, has been ameliorated by the new ideas; while we must not lose sight of the fact that we are still far from having reached the degree of improvement that modern justice and morals demand, which we should all strive to attain. Such are some

of the consequences of the scientific method—consequences which we are pursuing and shall realize, in the moral as well as in the material order, and despite all opposition; and in this way will come the universal triumph of science to assure the highest degree of happiness and morality to men.—*Translated for the Popular Science Monthly from the Author's Science et Morale.*

FEET AND HANDS.

By M. BERNARD (Mrs. HENRY BERNARD).

I.

IN the great family of the backboned animals, to which we ourselves belong, many different kinds of feet and hands are to be found, their shape showing a very wonderful relation to the manner of life of their possessors.

We are not going here to describe the fins of fishes, although many people believe that our feet and hands were developed from fins; we shall only deal with the true feet and hands found in animals higher than the fishes.

When we try to picture the foot or hand of any animal, we naturally think of it as we see it, often covered with fur which to a great extent hides its real shape. In our own feet and hands the true shape is more evident because the skin has lost its hairy covering. To obtain a clear idea of the feet and hands of different animals it is therefore better to limit ourselves to the bones which give them their firmness.

However different feet and hands may be, there is a certain remarkable similarity of plan in them all. In all, as in our own, there is a cluster of bones forming an "ankle" or a "wrist," and then running out from this a certain number of what we may call "rays." In each foot and hand there were once five rays, as there now are in our own, but in many animals this original number has been reduced, as we shall see. Each ray consists of several joints; the first joints are the longest, and are bound together by skin and flesh to form the sole of the foot or the palm of the hand, while the other joints form the free toes and fingers, the skin at their tips carrying nails or claws.

We can all trace this general plan both in our own feet and in our own hands, although in outward form our feet do not resemble our hands, and the work they have to do for us is so very unlike that it may seem surprising they should be built upon the same plan.

The explanation of this similarity of plan is very simple. Once,

very long ago, there was no difference in the work done by feet and hands; they were all used for walking, and were thus all, properly speaking, feet. So if we want to understand our feet and hands we must go back to animals which had four feet and no hands, the four feet each having five toes.

Fig. 1 is a drawing of the foot of a crocodile, which is probably not unlike the earliest kind of foot. At the end of the leg bones A and B we see several small bones, and, starting from these, five jointed rays which in the natural position lie flat on the ground. The fore feet and hind feet of the crocodile are almost exactly alike, having the same work to do—i. e., helping the animal to shuffle along the ground. This kind of foot is very well suited for reptiles, such as crocodiles and lizards, which lead a more or less lazy life, merely moving from place to place to find a patch of sunshine to lie in, or a spot which the animals or insects they feed on frequent, and where they can be snapped at easily. Some of these animals, it is true, are capable of darting at times with lightning speed, but this they seem to do by the help of their tails.

The clumsy, shuffling way of walking on the flat of the foot has been given up by most animals, but we still find it in some, such as the bears, which are called plantigrades or sole-walkers because of their flat-soled feet. The feet of the bear are very superior to those of the crocodile, for they are armed with claws which help him to hold prey and to climb trees; but his awkward, shuffling gait shows pretty plainly that the method of moving on the flat sole is not the best possible for running.

A better method of running is found in most of the higher animals, which no longer touch the ground with the sole of the foot, but only with the toes or digits, and are therefore called digitigrades or toe-walkers. Fig. 2 is the foot of a doglike animal (the wolf), and Fig. 3 is that of a catlike animal (the lion), and in both of these we see that the part of the foot which in ourselves we call the heel does not lie on the ground as in the crocodile or the bear, but is raised high above it, so that the animal walks, as we have said, on its toes or digits. The reason why this is a better method of running is that it gives extra length to the leg. A longer leg means a longer stride and greater speed. The wolves, hyenas, and foxes, which are doglike animals, and the lion, leopard, lynx, and all other catlike animals are beasts of prey—that is, they eat other animals which they have to hunt—and all in their turn are liable to be hunted, so they need to be able to run very swiftly. Many of the catlike animals, too, depend, both in attack and defense, quite as much on springing as on running, and so need to be very agile. For both running and springing we ourselves even use our toes and not the soles of our feet,

and these animals, with whom running and springing have become a constant habit, have come to use only their toes always; the heel no longer touches the ground except when the animal is crouching.

Now, in the foot of the crocodile (Fig. 1) it is seen that all the toes are not of the same length. If animals with such feet began to walk on their toes, some would not touch the ground. This, indeed, is what we find in many animals, especially in those cases where running is all that is required. In the feet of the dog, for instance,

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

only four toes touch the ground; the fifth toe, having long been less used than the others, has become very small. In the hind feet, which are used exclusively for running, the remains of the fifth toe can be felt as a small projection under the skin, some way up the back of the leg. In the fore foot of the dog, however, it is a distinct toe, with a nail, which is still used for digging.

In cats and dogs, as in the bears, claws are well developed. In the dogs they are short and hard but not very sharp, and are used chiefly for digging. The catlike animals, on the contrary, have very sharp, hooklike claws, which are of great use in seizing and holding prey.

It is obvious that if an animal, changing still further its method of walking, took to running on the tips of its nails or claws instead of on its toes, it would have a still greater length of leg, and therefore would be still better fitted for running swiftly. This remarkable manner of running is actually found in most of the swiftest four-footed animals, such as the horses and deer, and also in the cows, the sheep, and the pigs, which are therefore called ungulates, *ungula* meaning a nail. All these animals feed chiefly on grass, of which they need great quantities to nourish their usually large bodies. To obtain constant supplies of grass, in a wild condition, they have continually to roam from place to place. Their feet are admirably suited for these roaming habits, and also for very swift running, which is their best chance of escape from their enemies, the flesh-eating wolves, tigers, etc.

The foot of the bison (Fig. 4), in which the tips of only two toes

touch the ground, shows very clearly the position assumed by the bones of the foot in these animals. Not only are the heel and the first long joints raised above the ground, as in the dogs and cats, but the two remaining long upper joints join together to form one strong bone (Fig. 4 *), and none of the lower joints of the toes touch the ground. The nails of two toes which form what we call the "hoof" rest upon it, while at *a* we see all that is left of a third and fourth toe, possessed by the distant ancestors of the bison.

The chief distinction between the feet of the different nail-walkers is the number of toes whose nails form the hoof. Fig. 5 A shows us that the pig has four toes, but only two touch the ground and make the hoof; the other two are useless, and are gradually becoming smaller. The rhinoceros (Fig. 5 B) has only three toes, and these are not all equal in length, but all are in use and end in massive hoofs. The cow (Fig. 5 C) has only two toes, the upper joints of which have grown together into one as in Fig. 4 (for the bison is one of the cows) so as to form a long, strong part of the leg, the two very

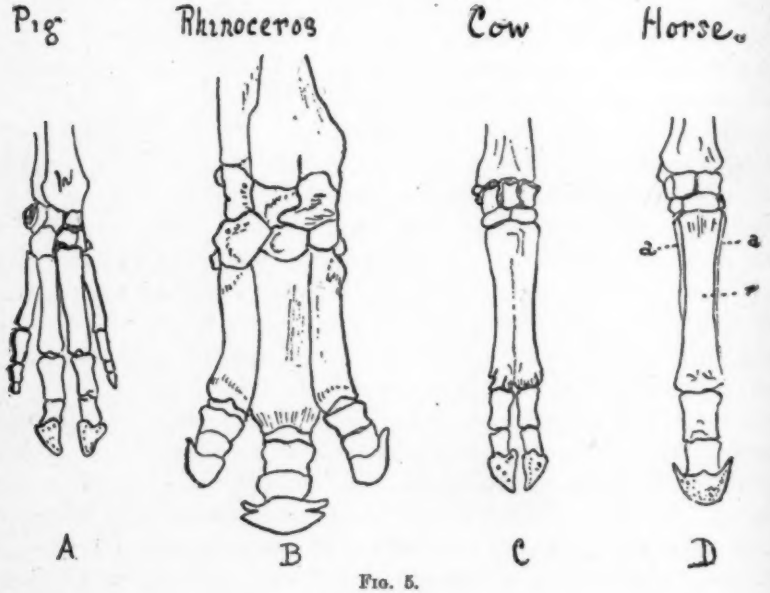


FIG. 5.

thick nails making a double hoof. This is what is called in the Bible a "cloven" hoof; it is not, however, as was supposed, a single nail split down, but two distinct nails belonging to two toes. Then, lastly, the horse (Fig. 5 D) has lost all its toes except one, which has become exceedingly thick and strong. The horse on its four feet, each ending in only one toe with its great nail, attains immense speed in running, great length being given to its stride by the length-

ening out of the one bone (*), which remains as the representative of the "sole" of the foot. Ages ago, as is proved by fossil remains, the forefathers of the horse of to-day had three, four, or even five toes. At *a*, *a*, on each side of the great single bone two thin bones can be seen. These two bones are the splint bones, the only remains now to be found of the vanished toes.

All the animals we have so far mentioned have four feet more or less alike, all being used for the same purpose, that of running. But some animals came to use their fore feet for one purpose and their hind feet for another, and in consequence of this the fore feet came to be unlike the hind feet.

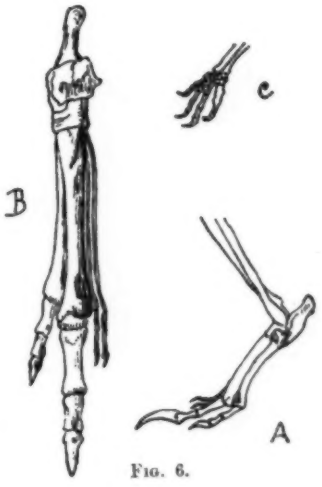


FIG. 6.

A striking example of such a difference in the use of the fore and hind feet, leading also to a difference in their structure, is found in the kangaroo, an animal which is seen wild only in Australia, where it hops or leaps over the open country, more or less upright, with extraordinary swiftness by means of its hind feet alone. When it rests, it sits on the long soles of its hind feet, steadied by its thick tail. Fig. 6 A represents the hind foot of a kangaroo in its ordinary position when leaping, and Fig. 6 B shows of what strangely changed bones it is composed. One ray has become very long and thick, and another, though not so long, is also fairly thick, but the other two are quite thin, as if they were dying away from not being used.

The fore feet of the kangaroo (Fig. 6 C) are never used as walking feet except when the animal is hobbling about slowly. Their chief work is grasping and tearing the leaves, grass, or fruit, or digging up the roots which form the food of the kangaroo. They are never needed to support the weight of the body, and so the toes are not large and thick, and four of the five toes are kept. In looking at the fore feet of the kangaroo one is tempted to call them "hands," for this very interesting difference in the use of fore and hind limbs in other animals, such as the monkeys, gave rise gradually to a true grasping hand.

In a second paper we shall deal with the extraordinary transformations of the fore feet into paddles and wings, found in whales, bats, and birds, and shall also see how true hands came to be developed in monkeys and in man.

CARL LUDWIG AND CARL THIERSCH.*

By Prof. WILHELM HIS.

GENTLEMEN: Our medical faculty, as well as the whole University of Leipsic, were plunged in deep sorrow at the beginning of the term. In the course of a few days we lost Carl Ludwig and Carl Thiersch, two members of our academic association who for years past have been accounted among its ablest supporters. The death of these two eminent men brings to its close a period prosperous and brilliant for our faculty, during which a circle of talented and congenial companions worked harmoniously together. One after another during the past eleven years has left us—Radius, Cohnheim, Wagner, Coccius, and Braune—the younger men in some cases before the older; and now two have followed whom we have always held in the highest honor, and without whom we could never have imagined our faculty as existing. An academic memorial service on such an occasion needs no further justification.

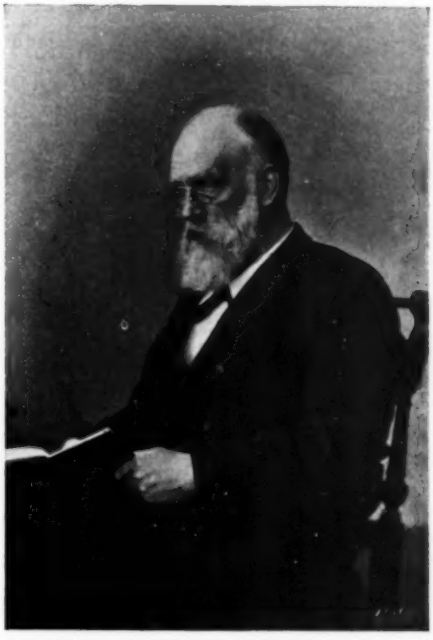
Carl Ludwig, Professor of Physiology, University of Leipsic. Born, December 29, 1816; died, April 23, 1895.

In the life of our universities, in spite of all seemingly uninterrupted activity and the continual substitution of failing powers by new and vigorous ones, a decided periodicity of development makes itself felt. In the whole university and in all the faculties, periods of rest and retrogression follow those of intellectual progress. External and internal conditions combine in producing this result, and it is not always easy to understand the influences at work. One fundamental condition, however, must necessarily be fulfilled in order that a corporate body may flourish: the body must have strong and clear-sighted leaders, who can direct its activity in definite channels, and insure a unity of purpose in all the departments.

Our faculty has had one of these leading spirits for several dec-

* Memorial Address. Translated by Ethel Bowditch.

ades in the person of Ernst Heinrich Weber, who in 1821 became professor of anatomy, and later (in 1841) also took the position of professor of physiology. His powerful personality has left its traces not only in the proceedings of our faculty, but still more noticeably in the sciences he represented and whose scope he extended in no small degree. Ernst Heinrich Weber, assisted by his brother Eduard, bore the double burden of the two important branches until 1865. In that year, however, it was decided to build a new physiological institute, and Weber, feeling that he no longer had sufficient strength to undertake the new duties that would now devolve upon the professor of physiology, decided to keep only his original position of professor of anatomy. Thus at Easter, in 1865, Wunderlich being at that time dean, Carl Ludwig was made professor of physiology and director of the new physiological institute.



CARL THIERSCH, Professor of Surgery, University of Leipsic. Born, April 20, 1822; died, April 28, 1895.

In these changes the royal government took the initiative. At the request of their noble ruler, King Johann, the far-sighted leaders of the ministry, Secretary of State von Falkenstein and Geheimrath Dr. Hübel, had undertaken the task of raising the University of Leipsic to new importance and splendor with all the means at their disposal. The physiological laboratory was planned as the first of a series of new constructions, the final object of which was to be a complete revolution of the entire system of scientific instruction. In the choice of Professor Ludwig the royal government made a most fortunate selection, for it secured in him a man whose judgment and powers of organization made him a most able adviser in all its subsequent undertakings. In von Falkenstein's time, Ludwig's influence extended far beyond the sphere of the medical faculty, and some of the most important appointments of that time were due to his suggestion. Later, when at last instruction in the natural sci-

ences had been organized in Leipsic, and the ministry of instruction had passed into other hands, Ludwig again confined himself to his own more limited department. His activity in this field, however, soon spread the fame of the Leipsic University throughout the world.

When Ludwig first came to Leipsic he was in the prime of mature manhood, and had already had twenty years of experience in teaching. He had begun his academic career in Marburg, in 1841, where he had been associated with his friend Ludwig Fick as demonstrator in anatomy. In 1849 he went from there to Zurich as professor of anatomy and physiology, and in 1855 he was called to Vienna to the medical military academy, the so-called Josephinum, as professor of physiology.

In 1852, during his stay in Zurich, Ludwig published the first volume of his text-book of Physiology, the second volume of which appeared four years later, when he was in Vienna. Ludwig's Physiology appeared like a meteor on the scientific horizon. It attacked the scientific knowledge of the day, demolishing former theories and conceptions with critical severity, and substituting new ideas and modes of expression which to us, the physicians of that time, seemed extraordinary enough. I well remember the sensations with which I, as an advanced student, on coming from one of Johann Müller's lectures, toiled through Ludwig's recently published work. Much that it contained I could only master by an effort, and much was actually repugnant to me, for it seemed to me to shatter to atoms the most interesting chapters of physiology as it had existed hitherto. And yet, in spite of all inward opposition, I could not resist the overwhelming influence of this powerful book with its vast stores of information, and I had to acknowledge more and more the force of its triumphant method of presentation.

Wherein lay the great step in advance that Ludwig had taken with his Physiology? Ludwig was a pronounced physical physiologist. A physical physiology had, however, existed long before his time. During the preceding two centuries there had already been schools of mechanical therapeutics in which classical works, as those of Borelli on animal movement, of Hales on blood-pressure, had been produced. Beginning in the second decade of this century, the Weber brothers had proved themselves investigators of the first rank, and their fundamental experiments on wave motion, the pulse, human locomotion, on muscular contraction, etc., were founded on a strictly physical basis. Other men of similar ideas, among them A. Volkmann, subsequently joined them. From the time of Lavoisier, works had been coming from France in which physiological questions were treated in a thoroughly physical method—the treatises of Dulong and Despretz on heat production and dissipation, those of Poiseuille

on the circulation of the blood, and, lastly, the exhaustive work on respiration by Regnauld and Reiset. Among Ludwig's personal friends, E. Du Bois-Reymond had between 1840 and 1850 constructed a theory of molecular physics of the nerve and muscle tissue, and Helmholtz, by means of wonderfully ingenious methods, had measured the rate of transmission of the stimulus in living nerves.

The road for physical investigations in physiology was, therefore, already open when Ludwig's book appeared. Moreover, the idea of a vital force, which on account of its obscurity had excited so much opposition, had now become meaningless for scientific investigation, and had besides received its deathblow through Lotze in 1842. What, however, was totally lacking before the appearance of Ludwig's book was a thorough introduction of physical reasoning and methods in physiological instruction. Anatomy was still the ruling branch of science even in physiology, and in some chapters of the latter the physiological problems were actually left out in favor of anatomical or comparative anatomical explanations. This was the more natural, because physiology was still taught by anatomists in most of the universities. Moreover, the regular course of instruction afforded the young physician abundant opportunity of acquiring a thorough anatomical education, while on the other hand a more rigorous training in physics was extremely difficult to obtain. Even to the present day this difficulty has never been satisfactorily overcome.

As anatomical demonstrator and professor, Ludwig himself had been through the dissecting room; he was all his life an excellent anatomist, and thought exceptionally highly of the mission of anatomy. However, in many ways his ideas of this mission differed from those of his predecessors, and even his language was often unlike what had hitherto been in use. He was especially energetic in opposing the idea that the mere description of forms could lead the way to a true understanding of physiology. The controversies between Ludwig and his opponents were vigorously carried on for several years, but at last they grew to understand one another better, and anatomists now have for years been accustomed to respect Ludwig as a valuable fellow-worker and one of the most eminent promoters of their science.

Perhaps nothing is more significant of Ludwig's point of view at the time of his first appearance than the arrangement of matter in his work on physiology. Ludwig's great predecessor, Johann Müller, had prefaced his manual of Physiology with a general chapter on organic matter, on organisms and life, and then proceeded to a description of the great vital functions: the formation and circulation of the blood, respiration, nutrition, etc. Ludwig, on the other

hand, began his presentation with a Physiology of Atoms and of Conditions of Aggregation. As an ideal form of investigation, he conceived the possibility of deducing the functions of complicated molecules from the conditions of their elementary construction, thence, however, to continue step by step to the tissues, and subsequently to the organs. Thus he thought to construct an intelligible theory proceeding from the simple to the complex, and at the same time to determine with mathematical accuracy the derivation of the one from the other in respect to direction, time, and quantity, and to prove the existence of each as the necessary outcome of a natural law.

The theoretical need of an elementary foundation for physiology caused Ludwig in his earlier years to study certain fundamental physical processes, such as filtration, diffusion, and the laws of hydraulics, with especial attention, and to make use of the knowledge thus obtained to explain the phenomena of animal life. Later he grew far more cautious as regards these explanatory experiments, and references to the organic connections of vital processes are much more frequent in his later work. He now speaks with especial predilection of the wonderful mechanism of life, the intricate workings of which, in all its complications, it is the duty of science to reveal.

I here quote a few words from the speech that Ludwig delivered on entering on his professorship at this university: "Physiology," he said, "has entered with full consciousness the sphere of mechanics, where rigorous laws obtain, and where the inexorable logic of circumstances rules the course of the atoms; but we, the heavily burdened servants of science, have armed ourselves with a thousand weapons with which to pursue the intangible phenomena of Nature, and, reflecting on these, we endeavor to understand the subtle mechanism of life. And when we finally receive our reward, when we at last comprehend an organ in all its connections, our proud consciousness is crushed by the knowledge that the human discoverer is but a bungler beside the unknown creator of animal life. For when man compares himself with him in the solution of any problem, he must ever fall short, as does the telescope compared with the eye, and the litmus paper with the tongue. And if all this was once clear, why must it needs again become obscure to us?"

If, however, we desire to understand Ludwig's full importance, we must seek him in his laboratory, and in the midst of his pupils, for here his most characteristic and noblest qualities reached their fullest development. A summary of Ludwig's and his students' work can only be indicated here. With his endeavor to make the construction of the body physiologically comprehensible, Ludwig, unlike some of his friends who were engaged in the same line of work, did not confine himself merely to physical experiments, but

devoted most of his activity to the far more difficult task of experimenting on the living body, a branch of work which in his hands and by his own inventions, the "Kymographion," the "Stromuhr," the mercury pump, etc., gained a precision that up to that time had never been imagined.

His inaugural thesis, that appeared in 1842, at first opposed by the Marburg faculty, treated of the secretion of the kidneys, a subject to the study of which he returned again and again in later years. Another very systematically arranged line of experiments led Ludwig in 1851 to the important discovery of the dependence of the secretion of the saliva upon the irritation of the glandular nerves, and to the recognition of the independence of the pressure of the secretion from that of the blood. This discovery was of fundamental importance for the physiology of secretion no less than for that of the nervous system, and it was at that time all the more surprising, since Ludwig's own suppositions had caused precisely the opposite result to be expected.

Constant objects of intense interest to Ludwig were the peculiarities of the circulating blood, its lateral pressure, and its rate of flow, as well as the dependence of these functions on the activity of the heart, on that of the muscles of the body, on the condition of the vascular muscles, and of numberless other factors. It is in this field that Ludwig's delicate graphic apparatus and his precise methods of measurement won their greatest triumphs. No less are our thanks due to him for a great part of the present knowledge of the mechanism of the heart's activity. It was he who first gave us an idea of the action of the lymph current in the living organism. He determined quantitatively its amount and its variations, and by histological investigations on the origin of the lymphatic system he threw light on the nature of this extraordinary apparatus. Ludwig labored incessantly to obtain a true understanding of respiration, including not only the gas exchange in the lungs, and the respiratory movements, but also the internal or tissue respirations. He was very successful in studying the activity of organs in the so-called state of survival which is produced by conducting a stream of blood through parts taken from a freshly killed animal, and thus the qualities of the blood, the lymph, as well as of various secretions, are determined and compared, both before and after the passage of the blood. When it seemed to him necessary to extend the anatomical foundations of physiological study, he always undertook this himself, or required students to make anatomical investigations. Among many other histological researches, we are indebted to him, above all, for his classic treatise on the structure of the kidneys. The most careful investigations of the blood-vessels of the eye and those of the inner

ear were also made in Ludwig's laboratory. In fact, by the establishment of the histological department of his institute, he exercised a marked influence on the development of minute anatomy.

If Ludwig's experimental methods were characterized from the beginning by their extraordinary precision, this quality was simply the result of the serious cast of his whole character. At whatever time one might happen to enter his laboratory, one always received the impression that it had just been put in order, and that every article was in its proper place.

The numerous investigations which Ludwig caused to be made on the most important parts of the body of course furthered the advance of medical science. The results of his researches benefited theoretical medicine, and his fully developed methods were of great advantage in experimental pathology and in clinical observations. Among Ludwig's pupils were a large number of eminent clinicians. Ludwig himself, however, always attached great importance to his relations to medicine and the practical significance of physiology. "Guiding the course of human life according to the dictates of human wisdom" is what in his great work on physiology he gives as his conception of the true aim of a physician, and later he several times expressed the same idea in somewhat different words.

It would be extremely interesting to follow more closely the influences that caused Ludwig to take up the physical side of physiology. This is now no easy matter to determine, and even inquiries that I have made among his surviving friends and pupils have given me no definite opinion. An accurate manner of thinking and great mental independence were always peculiar to Ludwig, and they were perhaps the qualities that caused him to turn aside from all beaten paths. As a student, this feeling of independence brought him into conflict with the laws of discipline in his university, and resulted in a temporary suspension of his studies there. On his return to Marburg he seems to have finally decided on making physiology his profession, and it was then that he entered Bunsen's laboratory. In the analyses that were undertaken there he probably had his first opportunity of becoming familiar with the more accurate physical methods. There he also had intercourse with other young physicists, among whom was Reiset. Bunsen's strict training must, indeed, have been a strong contrast to the unsystematic routine of the Bamberg surgeon with whom Ludwig had spent his time of suspension. From 1842 (the year of the inaugural thesis) onward he worked on the problems of physical physiology with his friends and pupils.*

* Among the standard works which he recommended to them at that time were the writings of the Weber brothers (Die Wellenlehre, 1825; the treatises on the pulse, absorption, auditory and cutaneous sensation, 1834; and the locomotive organs, 1834), Poiseuille's

When, in the course of a few years, the new school of physics in Berlin was formed, he entered on a correspondence with its representatives—with E. Brücke, E. Du Bois-Reymond, and H. Helmholtz. Ludwig's first opportunity of meeting these somewhat younger friends was in 1847, when he made a short visit to Berlin. It was then that he also made the acquaintance of E. H. Weber and A. Volkmann. He seems to have led Volkmann to the use of his recently invented kymographion, for, as is known by common report, they experimented together for a time.

In his manner of investigating, Ludwig was all his life a most acute analyzer, seeking with the utmost care to separate every vital process into its various branches, and to determine the conditions of its manifestations. In this work he always attached great importance to the quantitative determination of all the factors of the problem. This manner of work of course often resulted in the questions that he had investigated seeming further from a satisfactory solution than before he had begun; Ludwig, however, never regarded any line of research as definitely closed, but years later returned again and again to work on the problems he had undertaken to solve, and continued his researches with the help of his added knowledge and experience. Herein lay one of the most interesting sides of his richly endowed nature; in his search for the truth he never faltered, but with untiring energy continually attacked the problem with new weapons.

Ludwig's mode of scientific work was entirely opposite to E. H. Weber's. Weber possessed the gift of artistic intuition. He absorbed himself in his problems until he believed that he had mastered the main substance of the matter, after which he was able in a few clear strokes to draw an illustration of oftentimes wonderful simplicity. Weber's scheme of the circulation, constructed by the insignificant means of a piece of intestine and a few lamp chimneys, solved with one stroke, convincing even to beginners, some of the most abstruse problems of the theory of the circulation, and even the complicated technique of later physiology has not been able to dispense with it. The first one to recognize this was Ludwig himself; in fact, he went so far as to consider Weber's discoveries of greater importance even than Harvey's discovery of the circulation of the blood. Intuitive natures, such as Weber's, may make particularly clear teachers. The artistic perception, however, which is their most valuable quality, can not be transferred to others, and thus we seldom find them as founders of any school of science. Thus Weber, if we do not include his personally congenial friends, never in all his long career attracted scientific pupils. Ludwig, on the other hand, made

works on the circulation of the blood (1832), and Johann Müller's investigations on the formation of the voice.

a success in this direction with which in this country we can only compare Liebig's successful instruction in Giessen.

The power of attracting young men and interesting them in scientific questions was early noticeable in Ludwig. At Marburg, already in the year 1842, we find him working in connection with his scholars, or, as he always designated them, "his young friends," among whom some, such as C. Eckhard and Ad. Fick, afterward became his physiological colleagues. In the same way, during his six years' stay at Zurich, he gathered about him as fellow-workers in his researches all the stronger elements there. His power of attraction soon spread beyond the limits of the university, and later in Vienna, and finally here in Leipsic increased in a nearly geometrical rate of progression. The number of young men from all over the world whom Ludwig has guided to independent investigation has increased in the course of years to several hundred, and we see on the list some of the first names of our modern scientific world. Yet all Ludwig's pupils have all their lives looked up to him with deepest gratitude and affection, and have recognized how much they profited just from him in the line of intellectual education. "I owe Ludwig," a prominent investigator wrote me recently, "my scientific conscience, and instinctive repugnance to any bungling."

In trying to account for Ludwig's wonderful gift for teaching, I find the first main condition in his highly ideal spirit; the second, however, in his deep love on the one hand for investigating and on the other for aspiring youth. Only he who feels deeply can attach others to himself for any length of time. When Ludwig spoke of his pupils as his young friends this was no mere figure of speech; he was in reality personally interested in them, and even after many years had passed, still followed their later career with all the sympathy of a true friend. When he gave the young men who came to him scientific work to do, and with unselfish devotion taught them the first principles of physiological thought, interrogation, and method, his power of combining the qualities of teacher and fellow-worker was unsurpassed. He knew, moreover, how to deal with each one according to his particular nature, and the large field of work he controlled made it possible for him to give suitable work to pupils of the most varied talents and training. One he placed in the chemical laboratory, another before the microscope; to sensitively organized natures he gave delicate experiments to do, and even if a clumsy worker applied to Ludwig, he was not disappointed, but was placed in the care of that careful and experienced assistant, Salvenmoser. Even if such a pupil was never able to do independent work, he at least had the opportunity of learning by his own observation the great importance of order and precision in all scientific undertakings.

Ludwig's disinterestedness toward his pupils went to such an extreme that he allowed works that had been accomplished under his immediate supervision—generally, in fact, executed by his own hand, and also, as a rule, prepared for editing by him—to go out into the world under the name of the pupil who had assisted him. He not only did this in the latter years of his life, as a world-renowned scientist, but as early as the time of his stay in Marburg, at an age and in a position in which young men are usually less generous with their names. Under the names of Mogk, Spengler, Becher, and others, Ludwig's youthful investigations went forth, and when in 1847 he published his invention, the kymographion, under his own name, he apologized for it, saying that his young friend Gerau, then otherwise engaged, should really have done this. And yet in this case it was the question of one of the most important discoveries in natural history, in view of its later consequences. Ludwig, by means of his kymographion, introduced the principle of self-registering apparatus into science—a principle the importance of which may well be compared with that of the microscope, for it was first by means of such apparatus working as time microscopes that it became possible to directly observe and comprehend rapid and complicated processes.

As with the pupils in his laboratory, Ludwig also associated with his students with friendly sympathy. They all felt this, and returned it with warm attachment and respect. They usually attended each of his lectures two or three times, as the beginners were hardly able to master the information they received at the first hearing. In especial physiological conferences Ludwig gave the students opportunity of talking with him personally. For my part, it was a continual source of astonishment to me to see how accurately Ludwig was informed with regard to the industry and talents of the individual students.

Ludwig's workroom was a place to which the most heterogeneous elements had free access—foreign scientists, colleagues of all the faculties, physicians, friends, and pupils. There one might at any time seek his advice and enjoy the magic of his society. With his many-sided and thorough education, and his ever quickly roused enthusiasm for all sorts of new problems and lines of work, it was easy to interest him in questions of the most varied character. His great knowledge of the world and of human nature made his conversation a never-ending source of interest and information. Ludwig's point of view was ever lofty; the lines of thought on which he worked were always original, never commonplace. With his subtle humor he would occasionally maintain a paradoxical opinion. If, however, he was opposed by arguments that were repugnant to his idealism,

he was also capable of uttering bitter and sarcastic words. His conversation always inspired active thought.

Yet, with all the pleasantness of this social intercourse, his strict self-restraint, the strongest quality of his nature, was always manifest, and this was one of the principal causes of the excellent influence he exercised over young people; they had in him the example of a man who was scrupulously strict with himself, and absolutely conscientious. "Ludwig was also our professor of ethics," one of his American pupils recently remarked to me. And thus Ludwig's life has amply proved that the best and highest that a teacher can give to youth lies in the power of his own personality.

Ludwig's coming and the erection of the Physiological Institute caused a revival of theoretical instruction in our faculty. Two years later the arrival of Thiersch was followed by great changes in clinical instruction. Clinics have only existed in Leipsic since 1798. Up to that time the faculty had professors of pathology and surgery; learned men, who, however, gave no hospital instruction. Even when by the courtesy of the magistrate, and especially through the efforts of the excellent burgomaster Müller, the City Hospital had been opened for clinical instruction, the clinical teachers for a long time had only a subordinate position in the faculty. Only later, in 1812, the professor of clinical medicine (A. Clarus), and in 1824 the demonstrator of surgery (Kuhl) were received into the faculty as full professors.

A report of the faculty of the year 1838, written in Weber's clear handwriting, gives the key to a true understanding of these curious conditions. The Jacob's Hospital, in which the clinic was held, was then, as now, a city institution, the doctor and surgeon of which were appointed by the magistrate, and only later on were confirmed by the government. The first was appointed clinical professor, the latter surgical demonstrator. The financial support from the government was limited to four hundred thalers as a salary for the clinical professor, and one hundred thalers as a salary for the demonstrator of surgery.

The expenses of the hospital fell entirely on the city, the natural result being that the admission of patients was carried on without any reference to instruction.

The above-mentioned report complains bitterly of the existing conditions, and dwells on the fact that the sick-beds were almost entirely taken up by cases of chronic disease, which were practically useless for purposes of instruction. How curious it is now to hear that in 1838 the want of surgical cases was explained by the smallness of Leipsic and the "comparative wealth of the laboring classes"! The surgical demonstrator was subordinate to the clinical professor,

and his duties consisted merely in admitting students twice a week to his visits among the sick, and in winter demonstrating the most important operations on the cadaver. The faculty now in an entirely professional manner desired the government to provide clinical free beds, twenty medical and twenty surgical. To this request was added a list of suggestions for the organization of a course of instruction in clinical surgery, for the furnishing of a collection of instruments, and for a practical operative course.

The adoption of these recommendations of the faculty was the first decisive step toward a more perfect organization of surgical instruction; a second step was taken in 1841 through the appointment of Professor Günther, of Kiel, as professor of surgery and surgical demonstrator. Thus the existence of a regular surgical clinic in Leipsic dates back hardly fifty years. Even then the conditions of its existence were unfavorable enough, and hospital gangrene, in spite of the open-air barracks devised by Günther in the surgical department of the hospital, was a matter of inevitable recurrence. The surgical clinic only attained its full development a generation later, under Thiersch. It was also he who put an end to the unworthy subordination of the surgeons to the physicians.

Günther died in 1866, and after his death it is again a report from the pen of E. H. Weber which sets forth the point of view of the faculty. The first necessity seems to be now to provide a more suitably arranged hospital; the faculty therefore insists on the importance of appointing a man able to undertake the task of organizing its erection. This requirement was entirely fulfilled by the appointment of Thiersch in the following year, 1867.

At the time when the task of attending to the building of the new Jacob's Hospital with Wunderlich fell to Thiersch, the allied questions of surgical treatment and of hospital construction were undergoing a thorough revolution. As early as between 1850 and 1860 French physicians had recognized the mortifying fact that in English hospitals the number of successful operations was incalculably larger than in their own. The most careful examination of the conditions of both resulted only in the discovery of the far greater cleanliness and better ventilation of English institutions. Moreover, an English physician, Spencer Wells, had applied the principle of absolute cleanliness to operations in the abdominal cavity with startling success, thus making these previously almost necessarily fatal operations comparatively harmless. During the American civil war, important knowledge as to the best conditions for the treatment of wounds was gained. It was discovered that the wounded recovered most safely and rapidly in the airiest apartments, in lightly built barracks, or in open tents. Thiersch, with his keen insight, at once

recognized the advantages of the American system, and he was the first in Europe to have a large hospital built on the plan of barracks. In the Jacob's Hospital, which was built according to his directions, there are a great number of long-shaped buildings in a park, so distributed that the two long sides of each are free, and having at one end an airy veranda, into which beds may be pushed at any time. Air and light, these two "unpaid but invaluable assistant physicians," as Thiersch said, have free access to every patient. The system proved so excellent that in the course of years more and more barracks have been added, and the Jacob's Hospital has long been regarded far and wide as a model of such an institution. When, soon after the opening of the hospital in 1871, Lister's beneficent methods of surgical treatment were made public, it was again Thiersch who at once recognized their enormous significance, and advocated them with all his power. This beautiful hospital offered him the best possible conditions for the carrying out and further development of the newly acquired methods, as well as for their introduction in the education of the younger medical generation. There he worked during the past twenty-four years, not only as a teacher revered by all, but also as a faithful physician; and he so loved his hospital that even during his time of suffering he occupied himself ceaselessly with it, and one of the last wishes he expressed was that he might be able to return there once more.

Carl Thiersch, when he came to Leipsic, had occupied the chair of surgery in Erlangen since 1854, before which he had for six years been prosector in the Pathological-Anatomical Institute in Munich. He seems to have acquired his tendency toward surgery in 1850, during the second Schleswig-Holstein War, in which he served as volunteer physician under Stromeyer.

It is much more difficult to appreciate Thiersch's works in their connection than Ludwig's. In the case of the latter, when as a young man he came before the public, we have to do with an intellectual force of great intensity, and of a scientifically well-defined tendency. His whole life was given to the accomplishment of certain objects which he had placed before himself in the beginning of his career, and in following the course that was to lead him to his aim, he persistently sought, in all his work, to attract intelligent young men to his scientific researches.

Thiersch's development was of a different nature, and in order to understand what he accomplished it is necessary first of all to study his personality. Descended from a well-known scientific family, Thiersch brought with him the taste for thorough knowledge and for delicate intellectual understanding. He possessed the strict desire for truth and the independent disposition of the true scientist.

He loved, moreover, to absorb himself in especial problems, even when they really did not belong to his department. His address as rector at Erlangen on teaching and studying, and especially his Hamlet Glossary, show how much he also liked to devote himself to problems of human psychology. With all this tendency toward the subtleties of mental analysis, Thiersch was yet an accurate observer, and full of sound common sense. Endowed with such qualities, he easily developed into a clever and experienced judge of human nature. His fine command of language made him a spirited and much-admired speaker. As a general thing, however, he made sparing and thus most effective use of this gift, and even in expressing serious thoughts he often employed the weapon of a never-failing humor.

Thus Thiersch was one of those harmoniously gifted and well-rounded natures who have the power of accomplishing well any task that presents itself to them. As scholar, investigator, and physician, in the service of peace or of war, as well as now and then in executive positions, he always filled his place and accomplished excellent work. He never put himself forward, but rather let people and things come to him; yet nothing was further removed from him than ostentation, whether as regards his erudition or any other of his mental endowments. He preferred to hide his fine qualities beneath a mantle of dry humor. Those who did not see this absolutely conscientious man at work might well be doubtful as to his real earnestness. He was, however, extremely sensitive to vanity and obtrusiveness in others. When he met with these qualities, he could repel their owners severely by dignified reserve or by pointed remarks. The students who were aware of this danger perhaps avoided it with unnecessary care.

Thiersch's scientific works, whether on theoretic or practical questions, produce an impression of great maturity and perfection. Often original in their conception, they are always very careful in their plan and execution, and clear in the form of their presentation. His first printed essay, a medical dissertation on materia medica, still shows Schelling's youthful pupil. In the language of natural philosophy, he tries in it to deduce the action of medicaments from principles of the most abstract kind. But Thiersch did not remain long in this field. In his next works, which he undertakes as prosector, he proves himself already a creditable and thoughtful naturalist. It is the same in his investigations on pyæmia, on the formation of the sexual organs, and in his great experimental treatise on the origin of cholera. When Thiersch became a surgeon, his thorough theoretic knowledge was again and again of use to him, and he also was able to employ to great advantage his re-

markable skill in injecting fine blood-vessels. His most celebrated work is the monograph on epithelial cancer, in which he first determined with precision the origin of malignant tumors, and at the same time drew the most important practical conclusions from an essentially embryological idea. His excellent treatises on the healing of wounds and on transplantation of the skin are no less based on theoretical preliminary study. The certainty of his surgical methods was with Thiersch the result of his anatomical and pathological knowledge. In a thoughtful obituary notice, Professor Landerer, one of his former pupils, writes: "Thiersch's operating was the direct outcome of applied and pathological anatomy. With his phenomenal knowledge of these departments he could allow himself to build up his plan of operation directly on the diagnosis, and always to proceed as a free, creative worker."

Thiersch is reported to have said of himself that he was really an anatomist gone astray. In the interest of suffering humanity, however, it was surely well that he turned from anatomy to surgery, for he was a surgeon by the grace of God. He possessed not only the necessary firmness of eye and hand, but also a sovereign calmness that even in the most trying situations never failed him. Above all, the most beautiful quality that a great physician can have was his: he was possesssed of delicate sensibilities, and was thoroughly humane in his disposition. This last quality was perhaps the most prominent of Thiersch's many virtues, yet it was the one he endeavored most carefully to conceal. He burdened his heart with every one of his seriously sick patients; in critical cases he hurried to the hospital at the most unusual times, and if, contrary to his expectations, a serious operation resulted unsuccessfully, it was often days, and even weeks, as Landerer tells us, before he could reconcile himself to the result. He would criticise himself severely in order to determine whether he had not some mistake or neglect with which to reproach himself.

Thiersch's favorite resort was the children's wards. There he could devote himself to each without reserve. He remembered each of his little patients, and when, after their leaving the hospital, he occasionally met them in the street, he used to speak with them and inquire after their health. And for this the "Herr Geheimrath" was deeply revered by all who had been his patients, and it was a festival for them when his birthday or some other occasion gave them an opportunity of showing their affection by some little attention.

I should overstep the limits of an academic discourse if I followed further the tender side of Thiersch's personality. Yet one thing I must not pass over: that is, the beneficent influence of his humanity

upon his pupils. It is only too easy for young physicians to become callous to human suffering, which they are daily called upon to witness, and unless carefully guided by a teacher their manner toward patients may easily become inconsiderate. Like his deceased colleague, Wagner, Thiersch was one of those teachers whose benevolent dispositions exercised an ennobling influence over their pupils, and at once checked any tendency toward coarseness in word or thought.

The striking power of Thiersch's personality was at once felt by any one with whom he came in contact. His decisive bearing, his clear and sure judgment gained great respect for him in all circles. Among his surgical colleagues and at our academic meetings his opinion was depended on as a decisive one in all difficult questions.

As companions in the faculty, Ludwig and Thiersch supplemented one another admirably. Each one fully appreciated the other's value. Ludwig's aims were always of an ideal nature and always high. In the struggle to reach them he knew no compromise. It often seemed to me as if Ludwig, in his somewhat austere severity, was the embodied conscience of the faculty. Thiersch, on the other hand, with his intelligent insight, always knew where to find the starting point from which the object to be sought for was accessible. Both men were equal, however, in their sincerity and in the independence of their dispositions, both absolutely free from private considerations, and only anxious for the well-being of the institutions intrusted to them.

The names of Carl Ludwig and Carl Thiersch will be reverenced by our university for many years to come. Long will she be proud to have possessed two such large-minded and noble men. Such a possession is lasting in its consequences, for it will have an elevating and strengthening influence on coming generations. The memory of both men will always be blessed.

WHILE fully recognizing the influence of the inheritance of the imagination of his grandfather and the acute observation of his father on the formation of Darwin's scientific habits, Mr. A. R. Wallace mentions as other factors which have been usually overlooked the five years' voyage and his persistent ill health. During a very large portion of the five years on the Beagle, Darwin must have been practically alone and thrown on his own mental resources; and this mental solitude of an active mind, furnished continually with new and interesting facts on which to exercise the imaginative and reasoning powers, led to the formation of those original and suggestive ideas which were the foundation of his greatness. Hardly less important was the almost continuous ill health, which, while not preventing work or shortening life, obliged him to live in the country, free from the distractions of society, where his active mind could only be satisfied by continual study and experiment.

PRINCIPLES OF TAXATION.

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XIV.—DOUBLE TAXATION.

ONE of the inevitable characteristics of a "general property tax" is the opportunity afforded for inflicting double taxation—i. e., taxation at one and the same time on the same person or property, or taxation of the same property a second time in the same year—an opportunity which the believers in this system vigorously defend, and its administrators as a rule gladly take advantage of to practically enforce. These opportunities exist mainly through two assumptions, neither of which are warranted by either reason or justice, and are alike antagonistic to any equitable and intelligent system of taxation: the *first*, in respect to the *situs* of personal property, and the *second*, as to origin and nature of property; and to these, in the above order, attention is next invited.

Personal property for purposes of taxation is *popularly* divided into two classes—namely, things movable, tangible, and visible, and things wanting in corporality or bodily presence, and therefore, as a rule, intangible and invisible. To the former has been given the general name of "chattels," and to the latter that of "credits"; under which latter name or title are included not only book accounts, bills payable, promissory notes, bonds, mortgages, deeds, bank deposits, certificates of indebtedness, and the like, but also shares of corporate stock, and possibly shares in any partnership. Adopting a popular theory, that credits are property, their aggregate value in all civilized countries can not, probably, be reasonably estimated at less than one half of the aggregate value of all chattels and real estate.

SITUS OF PERSONAL PROPERTY.—As has been already pointed out, it is in the nature of an economic axiom and a fundamental legal principle that the power of every state to tax must be exclusively limited to subjects within its territory and legal jurisdiction. This economic axiom and legal principle is recognized in nearly all countries claiming to be civilized; the principal exceptions being in the States of the Federal Union, where it is violated in respect to both theory and practice—more especially in the State of Massachusetts, the statutes of which define personal estate for purposes of taxation so as to include "goods, chattels, money, and effects, wherever they are; ships, public stocks and securities, stocks in turnpikes, bridges, and moneyed corporations, *within or without the State*." Thus, for

example, if a resident of Massachusetts owns a cow which is bodily in another State, that cow is properly taxed in the State where the animal is; but Massachusetts, in virtue of the residence of the owner within her territory, imposes upon him a second tax for the same cow. Again, owners of shares in corporations chartered and located in Massachusetts are taxed through the corporation, and their shares are free from any further taxation. But if the same persons are shareholders in corporations created and established by other States, and the real and personal property of which are fully taxed where situated, they are subject to a second tax in Massachusetts on the assumed local value of the interest of their citizens in such extra-territorial corporations.

Under this system, moreover, the same property may be, and often actually is, subjected to not merely double but triple taxation, which sometimes practically amounts to confiscation. Thus personal property belonging to a citizen of Massachusetts, but located in Chicago, would be properly taxable there, because within the territory and under the protection of the taxing power. It would, however, be taxable to the owner in Massachusetts because of his personal residence in that State; and the owner would also be liable to taxation in Massachusetts by reason of his income from the same property. The following case of actual and comparatively recent experience constitutes both proof and illustration of the accuracy of this statement: A lady of a Western State, for the sake of availing herself of certain educational advantages, removed to a town in Massachusetts near Boston, and benefited the town by building a fine residence therein. Her property, which was held by a trustee in Indiana, was taxed to him by reason of his legal holding in that State. The property itself, mainly in another State, was taxed there, and properly, by reason of its location; but at the end of her first year's residence the lady was horrified to learn that a third tax on her income was demanded of her by the tax laws of Massachusetts. "And this," the person communicating these facts adds, "will, if enforced, be a decree of my personal banishment from the State as effectual as that which the State formerly launched against Roger Williams and the Quakers." Can any one doubt that human nature, as ordinarily constituted, will protest against, and successfully evade such laws? Would it not be well in discussing this subject to mention also that it was a question of taxation that gave liberty to the American colonies, and that the principle that the people of Boston and their ministers once mainly relied upon to justify their destruction of imported tea, which they regarded as unjustly taxed by even a small amount, was "that resistance to tyranny was obedience to God"?

The claim or argument, however, which the advocates of such

an unjust system now set up in its defense is not a theological one, but that personal property (more especially what is termed in law *choses in action*, or credits, titles, notes, bonds, mortgages, which are in their nature incorporeal, and therefore invisible and intangible) has no *situs* away from the person or residence of the owner, but is deemed to be present with him at the place of his domicile.*

This rule or fiction of law originated, according to Savigny, in Rome, and acquired the designation of "*mobilia personam sequunter*"; but its applicability to property was never held to extend beyond Roman territory. Subsequently it became a device of international comity, which the Supreme Court of Vermont (Catlin *vs.* Hall, 12 Vermont, 152) has declared was subsequently "adopted from considerations of general convenience and policy, and for the benefit of commerce"; and which, according to every principle of common sense and equity, was never invented with a view of its being used as a rule to govern and define the application and scope of taxation, or was intended to have any other meaning than that for the purpose of the sale, distribution, and other disposition of property any act, agreement, or authority which is sufficient in law where the owner resides shall pass the property in the place where the property is; and more especially to facilitate the distribution of decedents' estates, by enabling parties to dispose of their property without embarrassment from their ignorance of the laws of the country where it is situated.†

How comparatively recent, moreover, has been the extra-territorial application of the rule or principle under consideration to taxation, is shown by the fact that the first English colonists and lawmakers who came to America do not appear to have brought with them any of the narrow and illogical views which have characterized their descendants. Thus, for example, one of the earliest laws of the Massachusetts colony reads as follows: "*No man shall be rated here* (Massachusetts) *for any estate or revenue he hath in England, or in any forreine partes, till it be transported thither.*" (Massachusetts Historical Society Collections, vols. vii and viii, page 213.) And in the first provincial codes of Pennsylvania especial care was taken to confine taxation to land, and a very few articles of personal prop-

* This subject, from its modern and strictly legal aspect, will be discussed hereafter.

† "No fiction," says Blackstone, "shall extend to work an injury; its proper operation being to prevent a mischief, or remedy an inconvenience, which might result from the general rule of law." At any attempt to misapply a fiction, it falls within, and is terminated by, that other authoritative maxim of logic and the common law, *cessante ratione legis, cessat ipsa lex.* Another great authority in law, Lord Mansfield, says: "Fictions of law hold only in respect of the ends and purposes for which they were invented; when they are urged to an intent and purpose not within the reason and policy of the fiction, the other party may show the truth."

erty of a visible character, as slaves, horses, and cattle, and to exempt from taxation debts, accounts, merchandise,* and all other items susceptible of concealment, and which would necessitate inquisitorial methods for assessment. And it was not until 1847, when the State had become financially embarrassed by large expenditures, that any change was made in such system. But in later days, when laws came to be made by legislators who could not conceive that anything more was involved in taxation than the raising of a given amount of money, the discriminating rule in respect to the *situs* of real and personal property was generally adopted and has resulted in the before-mentioned absurdities. Another involved absurdity is that those States which adopt in their systems of taxation the rule of

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* In a report of the law committee of the Common Council of the city of Philadelphia, submitted February 16, 1871, we find the following historical review of the tax laws of Philadelphia, under the government of William Penn and his successors in the colonial government:

"These laws were framed to avoid repeating errors (in respect to the taxation of personal property) which had been proved by long experience in Great Britain and the Continental countries to be inquisitorial in their nature, and by concealment, evasion, and perjury demoralizing to the people. We find the Provincial Council (1683) first determining that 'a publick tax on land ought to be raised to defray the publick charge,' and the enactment of 1700, fixing county rates and levies (which law was not enrolled), is believed to have been not larger in the subjects of county rates than in the act of 1724, which were real estate, horses, cattle, sheep, negroes, and a poll tax. It will be noticed that the personal estate here enumerated was visible property not susceptible of concealment, and that debts, accounts, merchandise, and ships are nowhere mentioned. In the several enactments that followed in 1795, 1799, and 1834, the subjects of county levy were substantially the same, sheep and slaves being omitted in the last act, and officers added to the last two, and it was not until 1844, a period when the State, by large expenditures, had become embarrassed, that, by the act of 29th day of April, 1844, mortgages, money owing by solvent debtors, stocks, household furniture, public loans, watches, etc., were made taxable for county purposes. The attempted enforcement of this act was so injurious to the people, by driving capital and industrial establishments from the State, and so evaded in returns, that by common consent the law remained on the statute book a dead letter until the consolidation of the city.

"At that time (1854) the question was again discussed, and although the councils of the city had the power to impose the tax rate upon all the subjects of taxation, in the thirty-second section of the act of 1844 we find, by the first ordinances, they limited the levy to real estate, furniture, horses, cattle, and pleasure carriages, and so continued until 1864, when an act was passed empowering the city to levy taxes on all the subjects of taxation contained in that section of the act of 1844, a power which they possessed before, but had not exercised.

"Since that time the authority of the city to levy a tax on mortgages, stocks of Pennsylvania corporations, and occupations, has been repealed. In considering the enlargement of the subjects of levy in this city, the fact must not be lost sight of that the State does not impose any tax on real estate for State purposes, but derives all its revenue from corporation stocks and loans, mercantile license, tavern licenses, collateral inheritance, etc., and it is estimated that of the gross receipts for 1870 ($6,336,603) more than two fifths of the amount ($2,600,000) was derived from the property and business interests of the citizens of this city."

taxing property beyond their sovereignty or territorial jurisdiction, by reason of the possession of its owner, do not follow to a logical conclusion the principle they have adopted; for they do not hold that real estate, as well as personal property, follows the domicile of its owner for taxation But for this distinction no good reasons can be given, although pretexts, claiming to be reasons, may. One claim, however, is obviously as good as another. A robber who should draw romantic distinctions between watches and purses would fail in business. If we are to be robbers in practice, let us, at least, secure some grace by honesty in our professions, and admit that what we thus take is not a tax received as the just recompense of a benefit conferred, *but a compulsory levy, having its cause in our greed and its justification in our power;* and as these reasons are as good for a large levy as a small one, and the whole of a man's estate is greater than its part, why not take the whole? Still further, if it is right to tax a man in Massachusetts, who has come for a lengthened stay from another State or a foreign country, for the property he has left behind, why not the man who has come for a week? If we are to do business upon the principle that "might makes right," would it not be a brilliant stroke to station ourselves at all the avenues of ingress to a State, and cry "Stand and deliver!" to the passengers? From the above citations and arguments, the conclusion would seem to be inevitable that when a State assesses property situated beyond its territory and jurisdiction, and which its laws and processes are not competent or able to either reach or protect, or assesses one of its own citizens in respect to such property, the act has no claim to be regarded as taxation, but is simply *arbitrary taking*, in no respect different in principle from confiscation.

It will also be interesting here to recall some of the antecedents of this fiction of law, that personal property, irrespective of its *situs*, follows the owner for the purpose of taxation. Its prototype was the ancient *taille*, or tax of servitude, imposed on persons originally bondmen, or on all persons who held *in farm*, or *lease*, or resided on lands of the suzerain, and from which proprietors or suzerains of the land were exempt. And as no vassal could at will divest himself of servitude or allegiance to his lord or suzerain, so the obligation to pay taxes always remained upon him as a personal servitude, whatever might be the location of his property. In other words, the condition of the masses all over Europe during the middle ages was not unlike the condition of the slaves in the United States previous to emancipation. They (the slaves) had property in their possession, and spoke of themselves as owners of property, but in reality their property followed the condition of the servitude of their persons, and both persons and property belonged equally to

the masters. The *taille*, furthermore, as a badge of servitude, was supposed to dishonor whoever was subject to it, and degrade him, not only below the rank of a gentleman, but that of a burgher, or inhabitant of a borough or town; and "no gentleman, or even any burgher," says Adam Smith, "who has stock, will submit to this degradation." Now, the idea embodied in the word servitude is an obligation to render service, irrespective of or without compensation; and the idea upon which the taxation of personal property in this country has been based is, that the property owes a servitude to the State where the owner resides, irrespective of its actual location, in virtue of the obligation which its owner, as a citizen, may owe to the State by reason of the protection which the State gives him in respect to his person.

Again, in old times, the division of property into real and personal was wholly unknown; and under the common law all property was classed as lands, tenements, hereditaments, and goods and chattels. "In the course of time, however, leases of land for a term of years were classed as chattels, and were distinguished as *chattels real;* while other chattels, which did not savor of lands, were called *chattels personal*, 'because,' says Lord Coke, 'for the most part they belong to the person of a man, or else for that, they are to be recovered by personal actions.' And Blackstone tells us that 'chattels personal are property, and, strictly speaking, things movable, which may be annexed to, or attendant on, the person of the owner, and carried about with him from one part of the world to another'; and as instances he mentions money, jewelry, garments. Personal property, in fact, consisted almost entirely of such things as could be, and actually were, carried about with the person of the owner, or could be easily secreted. And Blackstone also tells us that the amount of the personal estate of our ancestors was so trifling that they entertained a very low and contemptuous opinion of it; and that our 'ancient law books do not, therefore, often condescend to regulate this species of property.' Nothing of an incorporeal nature, as credits, bonds, and mortgages, certificates of stock, was anciently comprehended within the class of personal chattels, and in fact there were few or no such instrumentalities for representing or facilitating the exchanges of property. It was otherwise as to lands or real property, as to which 'incorporeal hereditaments' occupied a conspicuous place from the earliest times. Such was personal property in the early history of our laws. It was of comparatively small importance, and its laws were few and simple; while real property, being of a fixed and permanent nature, was regarded as immeasurably more valuable, and was governed by laws of its own, of the most intricate and abstruse character. And because of

the feudal tenure by which lands were held arose the notion, which became a fiction of the law, that property, merely personal, always attended the person of its owner; while lands, tenements, and hereditaments, being fixed and immovable, and of infinitely more consideration, were held, from their very nature, as well as from motives of political policy, to have a *situs* of their own, from which they derived their laws and incidents, wholly regardless of the domicile of the owner. Growing out of the same reasons, it was also the prevailing opinion that, while immovables were exclusively governed by the law of locality, movables were controlled, according to the same maxim, by the law of the domicile of the owner, and not by that of its *situs*." In the changed condition of wealth and property, such a fiction, however suitable and useful in primitive times, would now, in many cases, work the greatest injustice, and impair the supremacy which every government should maintain over everything within its territory, both on the ground of public expediency and the private interests of its citizens. And, according to Wharton (Treatise on the Conflict of Laws, 1872), this fiction of law has been universally abandoned upon the continent of Europe, except in cases as to rights in respect to personalty which sprang from marriage and succession, and would not, furthermore, in Europe, find a place in any discussion of the principles of taxation, except possibly in a review of curious tax experiences, and for the reason that nowhere, except in the United States, is there any system of extra-territorial taxation, or any tolerance given to the ideas upon which it is founded.

This question of extra-territorial taxation has been raised repeatedly before the highest courts of the United States, and its *illegality* in respect to *visible, tangible property* is believed to have been in every instance affirmed.

Thus in the State of New York, up to the years 1861–'62, the rule of assessment of personal property appears to have been in accordance with that now recognized in Massachusetts—viz., that it follows the owner under all circumstances; but in that year a case of much importance was carried up to its Court of Appeals under the following circumstances: One Hoyt was taxed in the city of New York for personal property, and resisted the taxation on the ground that, although he had personal property outside of the State, he had none within the State in excess of his just debts and liabilities; the property in question without the State being capital employed in business in New Orleans, and farm stock and household furniture in New Jersey, each taxable by local law in the States where situated. The Court of Appeals decided the assessment to be illegal, and held (Comstock, C. J.) that the property was actually

situated in other States, in other sovereignties, protected by their laws and taxable there, and therefore it ought not to be subject to a second taxation in New York.

The court also, in rendering the decision, used the following language: "There seems to be no place for the fiction" (that personal property follows the owner) "in a well-adjusted system of taxation. In such a system a fundamental requisite is that it be harmonious, but harmony does not exist unless the taxing power is exerted with reference exclusively either to the *situs* of the property or to the residence of the owner. Both rules can not obtain, unless we impute inconsistency to the law and oppression to the taxing power. Whichever of these rules we find to be the true one, whichever we find to be founded in justice and the reason of the thing, it necessarily excludes the other; because we ought to suppose, indeed, we are bound to assume, that other States and governments have adopted the same rule. If, then, proceeding on the true principles of taxation, we subject to its burdens all goods and chattels actually within our jurisdiction without regard to the owner's domicile, it must be understood that the same rule prevails everywhere. If we proceed in the opposite rule, and impose the tax on account of the domicile, without regard to the actual *situs*, while the same property is taxed in another sovereignty by reason of its *situs* there, we necessarily subject the citizen to a double taxation, and for this no sound reason can be given."

In further support of its position the court made use of the following illustration: "A citizen, a resident of Massachusetts, may own a farm in one of the counties of this State, and large wealth belonging to him may be invested in cattle, in sheep or horses, which graze the fields, or are visible to the eyes of the taxing power. Now, these goods and chattels have an actual *situs* as distinctly as the farm itself. Putting the inquiry, therefore, with reference to both, 'Are they real estate, and personal?' so as to be subject to taxation under that definition. It seems that but one answer can be given to this question, and that answer must be according to the actual truth of the case. If we take the fiction instead of the truth, then the *situs* of these chattels is in Massachusetts, and they are not within this State. The statute means one thing or the other; it can not have double or inconsistent interpretations; and as this is impossible, so we can not, under and according to the statute, tax the citizen of Massachusetts with respect to his chattels here, and at the same time tax the citizen of New York in respect to his chattels having an actual *situs* there. *In both cases the property must be within the State, or there is no right to tax at all.*"

Since this decision by its highest court, personal property, though

owned in the State of New York, is not taxable to its owner there, provided it is capable of and has a permanent *situs* away from the owner or his domicile.

The United States Supreme Court (Hayes *vs.* Pacific Mail Company, 17 Howard, 713) decided that the *situs* of a vessel for State taxation is only at the port where it is registered, and not where it may happen to be.

In the case of The City of New Albany *vs.* Meekin (3 Indiana Reports, 481), the defendant was a resident of New Albany, and was assessed for personal property in respect to a steamboat enrolled at Louisville, Kentucky, and which touched only occasionally at New Albany. It was held that the tax was illegal, the Supreme Court observing that "the only question we have to consider is whether the boat or the defendant's share is within the city."

It is also an interesting circumstance that this legal controversy concerning the *situs* of a ship for the purpose of taxation has its almost the exact counterpart in the records of English law; case after case having formerly come up before the English courts in which the question involved was: Shall the ship or her owners be taxed at the place of the vessel's registry, or at the domicile of her proprietors? The ultimate decision was, that the only *situs* of a vessel for taxation is the port of her registry, and this decision was recognized in practice until Parliament and the people arrived at the conclusion that it was for the interest of the nation that ships should no longer be taxed directly in any manner.

The United States Supreme Court, in the case of the Northern Central Railroad *vs.* Jackson (7 Wallace 262), also affirmed the principle that two States *can not tax at the same time the same property, nor can a State tax property and interest lying beyond her jurisdiction.* The railroad corporation in question, extending from Baltimore in Maryland to Sunbury in Pennsylvania, was the result of the consolidation of four railroad companies, one incorporated by the State of Maryland and three by the State of Pennsylvania. The latter State imposed a tax of three mills per dollar of the principal of each bond issued by said road, which tax the company, at their office in Baltimore, deducted from the coupons of the bonds of said consolidated road held by Jackson, an alien, resident in Ireland. The court, by Mr. Justice Nelson, decided adversely to the tax, on the ground that the bonds were issued upon the credit of the line of the road, a portion of which was within the jurisdiction of the State of Maryland, and that the security, bound and pledged for the payment of the bonds and of the interest on them, embraces the Maryland portion of the road equally with that portion situated in the

State of Pennsylvania; respecting which condition of affairs the court used the following language:

"It is apparent, if the State of Pennsylvania is at liberty to tax these bonds, that to the extent of this Maryland portion of the road she is taxing property and interest beyond her jurisdiction. Again, if Pennsylvania can tax these bonds, upon the same principle Maryland can tax them. This is too apparent to require argument. The consequence, if permitted, would be double taxation of the bondholder, and its effect is readily seen. Thus a tax of three mills per dollar of the principal, at an interest of six per centum, payable semiannually, is ten per centum per annum of the interest; a tax, therefore, by each State, at this rate, amounts to an annual reduction from the coupons of twenty per centum; and if this consolidation of the line of the road had extended into New York or Ohio, or into both, the deduction would have been thirty or forty. *If Pennsylvania must tax bonds of this description, she must confine it to bonds issued exclusively by her own corporations.* Our conclusion is, that to permit the deduction of the tax from the coupons in question would be giving effect to the acts of the Pennsylvania Legislature upon *property and interests lying beyond her jurisdiction.*"

Again, the national (United States) bank act acknowledges, and the courts of the United States have so held, that a bank has a *situs* and its shares a *situs* where the bank is located, and not where the stockholders reside. The national bank act, therefore, discards the usual State principle of taxation, that personal property follows the owner.

A debt incurred for stock in a corporation has recently (1897) been held by the Appellate Supreme Court of New York as nontaxable, because the assets represented by the stocks are assessed and taxed.

But are credits, in any or all of the various forms in which they are exemplified, property? This question brings us face to face with another of those curious anomalies of opinion and practice that characterize this whole subject of taxation.

In most of the States of the Federal Union credits are generally regarded as property, and are made the subject of taxation at the residence or domicile of their owner, and are held to embrace all debts due from solvent debtors, whether on account, contract, note, bond, or mortgage, and stocks in moneyed corporations, irrespective of the place where such securities may be at the time the assessment shall be made. In States, however, like New York, which reject the assumption that the *situs* of *movable, visible,* personal property for taxation follows the owner irrespective of its actual location, and accept the decision of its own courts, that the *situs* of such property

for taxation is *where it is*, and independent of the domicile of its owner, the opposite rule is held to apply to credits.

On the other hand, in all other countries of high civilization, credits are not regarded as property in the sense of an actuality, and are not subjected to direct taxation. In France, which is at the present encumbered with a greater national debt than has ever before been borne by any nation, and where almost every expedient for raising revenue to defray its extraordinary national expenditures has been resorted to, no attempt or even a proposition has been made to tax credits. It is, therefore, of the first importance that the American public, and especially that portion of it that enacts tax laws, shall have a clearer and more correct idea of the nature of property than it now possesses; and that there shall be eliminated from all such laws the idea that extensively prevails in the United States, but in no other country, that "nothing" can be "something," if a statute will only so provide.

That there is some warrant and defense for such an idea is to be found in the fact that there is not a unity of opinion among economists on this subject; and that in common parlance and dictionary use the term "property" is made applicable to the qualities, rights, and titles of "things" equally with the things themselves. Thus, according to the ancient though still existing law of Scotland, what is termed "real property" in England is termed "heritable rights" in Scotland, and what is termed "personal property" in England is termed "movable rights" in Scotland. Ancient usage is, however, no warrant for the continued use of definitions not applicable to new conditions, and the acceptance of which as authority for conduct is provocative of immorality, injustice, and unsound fiscal policy. Prof. H. Dunning Macleod, a distinguished English economist, who has many adherents, has vigorously advanced the idea that everything that can be bought and sold is property, and assigns to the old Greek philosopher Aristotle the honor of its original conception; but without mentioning that at the period at which Aristotle lived there was practically nothing bought or sold except things tangible and visible, and that credits were practically unknown.

Attractive as this idea may be in theory, it needs but practical application to demonstrate its absurdity. Thus, when the Church sold "absolution" from sin, did the buyer, to quote from old Wycliffe, "have property in ghostly goods, in which no material or property may be regarded as inhering"? Service, again, is bought and sold; but when its purchase, as in the case of the hire of incompetent or dishonest persons, results in the impairment or complete waste or destruction of property, is it entitled to be regarded as property? When a ticket to a theater or concert is sold and bought, can the temporary

right to a seat, or the brief sense of pleasure which the purchaser receives in return, and which he can not perpetuate without renewed buying, and can not transfer to another person, be entitled to be called property? "When socialists and communists," says Professor Macleod, "wish to destroy property, it is not the material things they wish to destroy, but the exclusive right which private persons have in them." If this assertion is warranted, the question is pertinent, Why is it, when socialists or communists have the opportunity to destroy property, they rarely proceed against property over which private persons have exclusive control—like private dwellings—but rather against monuments or buildings, and constructions which are acknowledged to be public as respects use and control? Again, Professor Macleod further holds that not only is the right to a thing, which is not at the time of sale in existence, but is to be acquired in the future, property; but also that a *mere promise* to deliver a commodity is property of the same general nature as money and an actuality.

THE FOREIGN-HELD BOND CASE: A NEW CHAPTER OF PROGRESS. —Any review of this general subject of "double taxation" would be imperfect that failed to particularly call attention to a decision of the United States Supreme Court which, although of the first importance as touching the correct administration of a free and intelligent government, has thus far attracted little attention, even among members of the American bar.

The subject in question, furthermore, illustrates the historical principle that changes in free governments have more often been effected through the decisions of their highest courts than by direct legislation. Thus it is known to all who have examined the theory and practice of local taxation in the United States, that a hundred years ago or less, the lawmakers of England entertained very generally the same opinion in regard to this subject which is yet popularly accepted in this country, namely, that in order to secure exact justice and equality it is essential to attempt to subject all property of the taxpayer—real and personal, tangible and intangible, visible and invisible—to one uniform rate of valuation and assessment; although it must then, as now, have been evident to every one on reflection that, in order to attempt to do this, it would be necessary to endow the assessors with more than mortal powers of perception, so as to enable them to see what was invisible, and measure what was intangible and incorporeal (debts and credits, for example); and that, in default thereof, any practical application of this theory must result in rank absurdity and injustice. And yet it is curious to note that the change in English taxation, when it came about, was not due to any such process of reasoning on the part of the people, or to

any positive sentiment on the part of the state, but rather to a series of legal decisions by its courts, which gradually undermined the whole system of British local tax assessment, until it tumbled down, as it were, imperceptibly, and gradually became replaced, from necessity, by a theory which approximated more closely to the principles of sound political economy and the dictates of common sense.

Thus, one of the first of the old-time maxims which gave way under these decisions was the fiction of law that all property for the purpose of taxation followed the person or domicile of the owner (in virtue of which real estate was once taxed, under the British system, where the owner resided, in place of where the property was situated, used, and protected), and its replacement by the more rational principle that for all purposes of assessment the *situs* of property is where the property actually is; while other decisions of a similar character, following one another by intervals of years, forbade the taxation, for local purposes, of all evidences of national indebtedness, or "consols"; affirmed the *situs* of a vessel for taxation to be at the port of its registry, irrespective of the domicile of the owner; and declared that all negotiable instruments are chattels personal, and the like; until the British system of local taxation, like the French, Belgian, and German, has come to be based on the assessment of comparatively few objects, and the avoidance in assessment, to the greatest possible extent, of all personal inquisition and arbitrary treatment.

A case in question determining definitely, as it would appear, the hitherto questionable *situs* for State taxation of all that large class of personal property comprised under the general term "*negotiable instruments*"—i. e., State, municipal, railroad, and other corporate bonds, circulating notes of banking institutions, promissory notes payable to bearer, etc.—is reported in the fifteenth volume of Wallace, under the title of *State Tax on Foreign-held Bonds*, and in brief may be thus stated:

The State of Pennsylvania, by a law passed in 1868, required the officers of every company, except banks or savings institutions, incorporated and doing business in that State, to retain a tax of "five per cent" upon every dollar of interest paid by such company to its bondholders or other creditors, and to pay over the same to the State Treasurer for the use of the Commonwealth. The plaintiff in this specific case—the Cleveland, Painesville, and Ashtabula Railroad Company—denied the legality of the tax, and, appealing to the State courts, alleged, among other things, the following in support of its position:

"That the greater portion of the bonds of the company having been issued upon loans made and payable out of the State to non-

residents of Pennsylvania, citizens of other States, and being held by them, the act in question, in authorizing the tax upon the interest stipulated in the bonds, so far as it applied to the bonds thus issued and held, impaired the obligation of the contracts between the bondholders and the company, and was therefore repugnant to the Constitution of the United States and void."

The several State courts of Pennsylvania, however, affirmed the validity of the tax; but the case having then been carried on writ of error to the Supreme Court of the United States, the latter in December, 1873, reversed the judgment of the State courts, and decided in favor of the plaintiff; the opinions of the court, as expressed by Mr. Justice Field, being substantially as follows:

I. *The power of taxation of a State is limited to persons, property, and business within her jurisdiction; all taxation must relate to one of these subjects.*

II. *The tax laws of a State can have no extra-territorial operation; nor can any law of a State inconsistent with the terms of a contract made with and payable to parties out of the State have any effect upon the contract while it is in the hands of such parties or other non-residents of the State.*

III. *Bonds issued by a railroad company are property in the hands of the holders, and when held by non-residents of the State in which the company was incorporated are property beyond the jurisdiction of the State.*

It will be observed under the *third* head (the language above quoted being the official prefatory syllabus of the decision) that the court lays down the rule that negotiable bonds are property, not in the place where issued, as was claimed by the authorities of Pennsylvania, and not at the domicile of the owner irrespective of actual presence, as was generally claimed by the State tax officials, *but in the hands of the holders at the place where the bonds are actually situated,* whether the holders be actual, *bona fide* owners or otherwise. And the following is the exact language in which the decision was expressed:

"It is undoubtedly true that the actual *situs* of personal property which has a visible, tangible existence, and not the domicile of its owner, will in many cases determine the State in which it may be taxed. The same theory (i. e., the actual *situs* determinative) is true of public securities consisting of State bonds, and bonds of municipal bodies, and circulating notes of banking institutions; the former, by general usage, have acquired the character of, and are treated as, property in the place *where they are found, though removed from the domicile of the owner;* and the latter are treated and pass as money wherever they are."

If, now, there is any meaning in words, and if the authority of the United States Supreme Court in defining the powers and jurisdiction of the States is as absolute as is generally supposed, it is clearly evident that the first clause of the above-quoted opinion effectually establishes the unconstitutionality and illegality of the theory and practice of Massachusetts and other States, namely, that in virtue of jurisdiction over the person and domicile a State has a right to tax so much of the visible, tangible, personal property of its citizens—i. e., horses, cattle, stocks of goods, money, bullion, and the like—as may be *without its territory and jurisdiction:* the law of Massachusetts, for example, defining personal property for the purpose of taxation to be "goods, chattels, money, and effects, wherever they are." *

If it be objected that the court, by using the expression "in many cases," does not make its rule absolute and unqualified, the answer is that the exceptions, when understood, will be found to be of a character which proves and strengthens the rule, rather than antagonizes it. Thus, as has been already noticed, the United States Supreme Court has decided that the *situs* for taxation of vessels which move about on the high seas or navigable inland waters must be at the home port where they are owned and registered; and it also stands to reason that the *situs* of such property as railroad cars, or other chattels which as a condition of using are perpetually *in transitu*, in order to avoid duplicate taxation and conflicting statutes, must be taxed, if taxed at all, under the head of the franchise of the company or owners. But in all cases where fixity, or permanence are conditions of using, it may be unquestionably affirmed that the court intended to make no exception in its rule for determining where visible, tangible, personal property may be taxed, and where, also, it is of necessity exempted from taxation.

Taxation and Protection correlative.—It ought to be superfluous, but in view of existing opinions and practices it is nevertheless expedient to say that the reason of this rule is founded upon a circumstance alike conformable to law and common sense, which is that taxation and protection are correlative terms; or, in other words, according to the political theory of our governments, national and State, and, in fact, of every government claiming to be free, that taxes are the compensation which property pays to the State for protection; or, as Montesquieu, in his Spirit of Laws, has

* In Massachusetts, within the last half century, a citizen has been threatened with arrest and imprisonment for objecting to pay taxes in that State on goods located in a store in San Francisco and paying taxes thereon in the State of California. Bullion in the vaults of the Bank of England has also been taxed to citizens of Massachusetts as personal property within a comparatively recent period.

it, and as the United States courts have again and again expressed it, that "the public revenues are a portion that each subject gives of his property in order to secure and enjoy the remainder." When, therefore, a State like Massachusetts assesses property situated beyond its territory and jurisdiction, and which its laws are not competent or able to either reach or to protect, or assesses one of its own citizens in respect to such property, the act has no claim to be regarded as taxation, but is simply arbitrary taking, or confiscation, and a procedure which the United States Supreme Court has, at least in the case under consideration, declared to be unconstitutional, and therefore illegal and unwarranted. But the Supreme Court of the United States has placed itself on record before in respect to the principle that protection and taxation are correlative; and in another case, which appears almost wholly to have escaped the attention of the American bar and public, its decision is invested with a historical as well as a legal interest. Thus, in September, 1814, the country being then at war with Great Britain, the town of Castine in Maine was captured by the British, and remained in their exclusive possession until after the ratification of peace, in 1815. During this period the British Government exercised all civil and military authority over the place; established a customhouse, and allowed goods to be imported, which goods remained in Castine after it was evacuated by the enemy. After the re-establishment of the American Government, however, the United States collector of customs, claiming a right to American duties on the goods in question, demanded payment of the same from the owners or importers, and, the claim being resisted, the case went up to the Supreme Court, where Judge Story, then upon the bench, gave judgment for the defendants as follows:

"We are all of the opinion that the claim for duties can not be sustained. By the conquest and military occupation of Castine, the enemy acquired that firm possession which enabled him to exercise the fullest rights of sovereignty over that place. The sovereignty of the United States over the territory was of course suspended, and the laws of the United States could no longer be rightfully enforced there, or be obligatory upon the inhabitants who remained there and submitted to the conquerors. By the surrender, the inhabitants passed under a temporary allegiance to the British Government, and were bound by such laws, and such only, as it chose to recognize and impose. From the nature of the case, no other laws could be obligatory on them; *for where there is no protection, or allegiance, or sovereignty, there can be no claim to obedience.*"

But to return to the subject more immediately under consideration. The court having thus affirmed the *situs* for the taxation of

personal property which has a visible and tangible existence, has now taken a further step forward, and in the second clause of the opinion above quoted asserts that "the same thing is true of public securities consisting of State bonds, and bonds of municipal bodies, and circulating notes of banking institutions"; namely, that their *situs* for assessment and taxation is wholly irrespective and apart from any whereabouts of the owner or his domicile, but is where the securities actually are. So much, then, is so clear that even the most obstinate of assessors under the present arbitrary system will find it difficult, in respect to the items specified, to interpret the law and rule of action otherwise. But it is to be observed that negotiable railroad bonds are not, in the opinion quoted, specifically mentioned.

That they, however, follow the same law as municipal and State bonds, and were intended by the court to be included in the same category, is, however, obvious, for the following reasons:

1. The subject-matter of the case and of the decision was a railroad bond.

2. The character of a railroad bond as a negotiable instrument is in all respects the same as a State or municipal bond.

3. The reason which undoubtedly led the court (as it must every unprejudiced reader who thinks upon the subject) to the conclusion that State, municipal, and railroad bonds and bank notes follow the same rule, in respect to their *situs* for taxation, as other personal property of acknowledged visible and tangible character is that the property of all such instruments runs with the instrument, wholly irrespective of the residence of the owner, and consequently, in respect to title, passes by delivery. By public securities, also, the court undoubtedly meant all negotiable securities which are payable to the public—that is, to bearer wherever he may be; or, in other words, a public security, from its very nature, is subject to no previous equities between the original parties creating or issuing it, and the sum agreed to be paid is a liquidated and adjusted sum which must be paid to the public—that is, the holder; and the *situs* of such property from necessity follows the instrument to the public, and can be nowhere else than where the instrument actually is. On the other hand, if the instrument was subject to equities, the property might be where the parties creating it or owning it resided. And if this position is not correct, dealings in all such securities, or upon the stock exchange, or in open market would be impracticable; inasmuch as the purchaser would be obliged to institute an investigation as to whether the title for each specific bond vested in the vendor or some other person; and as there is no registration of the transfer of such property, as there is in the case of real estate, the

investigation must be practically impossible. So, also, in the case of circulating notes of banking institutions: if their title did not pass by delivery, or, in other words, if their *situs* as property was not under all circumstances accepted as in the hand of the holder, their use as money would be impossible; and the courts, recognizing this principle most fully, have always held that in cases where negotiable instruments or money have been stolen, and in consideration for value received have come into the hands of innocent third parties, the title to such property in the hands of the holders is perfect and irrevocable.

Again, the circumstance that State, municipal, and railroad bonds, and all other strictly negotiable instruments, even warehouse receipts payable to bearer, are subject to attachment by legal process only at the place where they actually are, and without regard to the whereabouts of the owner or his domicile, of itself also clearly defines and limits the *situs* of such property for taxation; for clearly a State which has the power to make a legal attachment operative against a given property has also the power to tax such property; while, on the other hand, a State which through lack of possession and jurisdiction, can not attach a specific property, certainly can not enforce its tax laws against it, or give protection in case its rights or the rights of its owner are violated. And, again, can the right to tax personal property exist in a State from which the property is so confessedly absent that there is neither right, power, nor possibility of passing title to it within the territory of the State by delivery?

That the view thus taken respecting the *situs* of negotiable instruments, and especially of railroad mortgage bonds, for taxation, is in strict conformity with the opinion of the Supreme Court, is also evident from the fact that in summing up the court held that not only was a mortgage bond issued by a railroad chartered by Pennsylvania, and in the hands of a non-resident, property out of the State, and as such beyond the jurisdiction of the taxing power of the State, but also that the State could not tax such property even when owned by a citizen and resident, unless the bond was at the time of assessment actually within the territory of the State. And as this point is a most important one, it is desirable to ask attention to the exact language of the court establishing it.

"We are clear," says Justice Field, "that the tax can not be sustained; that the bonds, being held by non-residents of the State, are only property in their hands, and that they are thus beyond the jurisdiction of the taxing power of the State. *Even where the bonds are held by residents of the State*, the retention by the company of a portion of the stipulated interest can only be sustained as a mode of

collecting a tax *upon that species of property in the State. When the property is out of the State, there can be no tax upon it for which interest can be retained.* The tax laws of Pennsylvania can have no extra-territorial operation."

The decision of the United States Supreme Court, of which an analysis has been above given, ought therefore to be regarded as constituting a real chapter of progress in American local taxation; because, by contributing powerfully to break down the present popular system, which, founded on an erroneous and impracticable principle, never has been and never can be executed with justice and efficiency, the time is thereby hastened when a better system shall be accepted and inaugurated. The logic of this decision, moreover, will not only pervade courts—State and Federal—but will be felt in legislative halls, and be impressed upon the conscience of the people. The court itself, in referring to the tax under consideration, says with great point and truth: "*It is only one of many cases where, under the name of taxation, an oppressive exaction is made, without constitutional warrant, amounting to little less than an arbitrary seizure of private property. It is, in fact, a forced contribution levied upon property held in other States, where it is subjected, or may be subjected, to taxation upon an estimate of its full value.*"

But this new decision teaches us that all personal property, if taxed at all, must be taxed in the city or town where found, and not elsewhere. The injustice and oppression are also the same as in the case of State exterritorial taxation when the tax is levied upon a person for property not within the district where the property is actually located and protected. It is only a degree of oppression, and this authoritative opinion of the United States Supreme Court can not fail to give a new impulse to the feeling that taxation without protection is merely legalized brigandage.

"WHY do we study animals at all?" asks Prof. L. C. Miall, in his British Association address. "Some of us merely want to gain practical skill before attempting to master the structure of the human body; others hope to qualify themselves to answer the questions of geologists and farmers; a very few wish to satisfy their natural curiosity about the creatures which they find in the wood, the field, or the sea. But surely our chief reason for studying animals ought to be that we would know more of life, of the modes of growth of individuals and races, of the causes of decay and extinction, of the adaptation of living organisms to their surroundings. Some of us aspire to know in outline the course of life upon the earth, and to learn or, failing that, to conjecture, how life originated. Our own life is the thing of all others which interests us most deeply, but everything interests us which throws even a faint and reflected light upon human life."

ABORIGINES OF THE WEST INDIES.

By LADY EDITH BLAKE.

SOME little interest having again been awakened in the outside world concerning the West Indian Islands, the question is occasionally asked, Had those islands any aborigines when discovered by Europeans? If there were natives, do any of them remain? Both questions may be answered in the affirmative. The West Indies, or Antilles, consist of many hundreds, or even—reckoning keys or very small islands—several thousand islands varying in area from those which, like Cuba and Jamaica, number their square acres by the million, to the tiny key of half an acre or less. The greater number of these—indeed, all capable of supporting a population, with the exception of Barbados—contained inhabitants when first discovered. Barbados, though containing numerous evidences of former occupation, was uninhabited when taken possession of by its first European settlers, the English.

The peculiar interest attaching to the meeting between the European navigators and the Western barbarians is that—putting aside the discoveries of the Northmen in the tenth and eleventh centuries—it is the first meeting between modern and prehistoric man of which we have any account. Till the beginning of the nineteenth century the civilized world knew little or nothing of prehistoric man, and prehistoric anthropology was an unknown science. To have stated that man had existed on the earth more than four thousand years B. C. would have been regarded as heresy, and to have held that he had roamed over Europe when the mammoth crashed through its forests, and when the stately megaceros and reindeer browsed on its bogs, would have been considered the wildest folly. The stronger light that is being thrown on those times of long ago first shone in Denmark, where the study of runic stones and characters led to the disclosure of evidences of human occupation of that country far earlier than had ever heretofore been suspected. Subsequently, the finds at Abbeville, the discovery of the lake dwellings in Switzerland, the investigations in the caves of Kirkdale and Kent's Hole in England, with others too numerous to mention, awoke widespread interest in the newly arisen branch of investigation; learned men began to compare the remains and relics of the aborigines of America with those of Europe, and at length began to recognize that when Columbus landed on Guanahani, and was met by its painted and trembling inhabitants, the people of the Old World, instead of finding men of a new kind, were in reality standing face to face with men such as in Europe had been extinct for nigh two thousand years. This it

is that gives such fascination to the descriptions left us by those who first saw men who were living very much as must have done the owners of the Cro-Magnon and Neanderthal skulls, and that lends such peculiar interest to all vestiges and traces that have been preserved of a people secluded from all contact with those more enlightened than themselves.

Fortunately, there is considerable material available for so interesting a study. Besides relics of the aborigines in the shape of skulls, bones, stone and wooden implements, and rock-carvings, some of which are more or less abundant in most of the islands, the early writers have left us graphic descriptions of these people, their manners and customs; and they give us the facts as they passed before their eyes, without any endeavor to bend such facts to the support of their own pet theory, or to explain what they did not understand, save by the usual and satisfactory method of assigning everything of which they disapproved or for which they could not account to the agency of the devil.

It is indeed fortunate that the discoverers have given us so many details of what they saw in those beautiful islands, which they flattered themselves were the outposts of the empire of the Great Khan, for the people they saw there have long since passed away, leaving no posterity behind them, save in the case of the Caribs of Dominica and St. Vincent. The Lucayans of the Bahamas, the Arrowauks of Cuba and the larger Antilles have for the last three hundred years or so been extinct. It is true that at Parottee Point, in Jamaica, a few of the fishermen claim to have Indian blood in their veins, and one old man assured me he was a pure Indian by descent. These people had straight black hair, and were decidedly different in feature to their negro neighbors. However, in all probability the Indian element is accounted for by Indians having not infrequently been brought to Jamaica either from the Mosquito coast or Florida. Sir Hans Sloane, who came to Jamaica more than two centuries ago as physician to the Duke of Albemarle, speaks of Indians there—

> not natives of the island, they being all destroyed by the Spaniards, but are usually brought by surprise from the Mosquitos or from Florida, or such as were slaves to the Spaniards and taken from them by the English. They are very good hunters and fishers, but are naught at working in the field or slavish work, and if checked or drubbed are good for nothing, therefore are very gently treated and well fed.

Curiously enough, at the present day the people claiming Indian descent in Jamaica are still expert fishermen.

I was informed by General Légitime, ex-President of Haiti, that in that island, in the wild, forest-clad mountains beyond Jacmel, people live in the woods who never visit the towns or hold any com-

munication with the present owners of the island, and who are believed to be descendants of the native Indians. It would be interesting if some communication with these people could be established, but meantime it is as likely they may be Maroons as Indians, for all concerning them is too vague and uncertain to allow at present of their being regarded as representatives of the aborigines.

In Dominica, St. Vincent, and Trinidad a few of the primitive inhabitants still remain. They are Caribs, who were a fierce and warlike race, the bitter enemies and persecutors of the comparatively mild and inoffensive Arrowauks. Both tribes still exist in Guiana, and apparently have forgotten their old differences. It is probable that the Arrowauks were the earliest arrivals in the islands, but when their migration from the mainland took place there are not sufficient data for saying: all we know is that it must have been long ages before the arrival of the Europeans. In Hispaniola (now the negro republics of Haiti and Santo Domingo) the absence of any legend of a distant origin would allow of the native Indians having had a legitimate claim to being an autochthonous race, or at any rate points to the great length of time that must have passed since their canoes had carried them across the breezy Caribbean Sea, from the cradle of their race far away in the dense and mysterious forests of South America. The Indians of Hispaniola, like many others of their brethren, handed down their histories and traditions in songs which were chanted before the people on festivals and other great occasions, and which were often accompanied by dances. On great occasions they danced to the sound of a drum made out of the trunk of a tree and played by a cacique. In these songs or hymns the tradition was recorded that the first men came out of two caverns in the island. The sun was irritated at the advent of mankind, so changed the guardians of the caves into stones, and metamorphosed the men who had escaped from the caves into trees, frogs, and different animals. In spite, however, of these efforts on the part of the great luminary, the world became peopled. Another tradition declared that the sun and moon themselves had come out of a cavern in Haiti.

The traditions of the Lucayans, on the contrary, all pointed to the Lucayans having come to those islands from a land to the south, so probably their residence in the Bahamas had not been for so long a period as to blot out all recollection of the large islands where their race had struck such firm root on its migration from the mainland. That the Arrowauk occupation of the islands had been of long duration, a mass of evidence appears to show. In Cuba artificially flattened skulls have been discovered imbedded in lime rock in caves near Cape Maisi. With them were found fragments of pottery, an

earthen jar containing bones, and some stone axes or celts, popularly known as "thunderbolts." In Jamaica we ourselves found pottery and bones imbedded in a cave in the rocks, out of which we had to break them with a machete, or cutlass. In the Jamaica cave, however, the lime in which the bones were incrusted appeared to be of stalactitic nature, and may have been deposited more rapidly than would have been the formation of true limestone. The district in which the cave is situated (the St. John's Hills, Guanaboa) is a very dry one, and there was no appearance of any drip from the roof or sides of the cave when we visited it; so it may be assumed that the incrustation must, in any case, have been a slow process. The Indians had been exterminated in Jamaica for a considerable period before its occupation by the English, which took place in the days of Cromwell, so even a low computation of the lapse of time must assign a respectable antiquity to the incrusted pottery and bones. When more extensive researches and explorations take place, it is possible that traces of human presence may be discovered in some of the older rocks or strata of some of the islands.

That all the larger islands were inhabited by a race which was divided into tribes, some of which spoke different dialects, but which derived their origin from the same stock, is shown not alone from evidence afforded by skulls, pottery, and implements, but from the fact of identity of language. On Columbus's first voyage he carried home with him some of the natives to exhibit in Spain. Among these was a boy named Didacus, taken by the admiral from Guanahani, now generally known as Watling's Island, the scene of the landfall. We are told that Didacus "was a man from his child's age, brought up with the admiral." Later on he sailed with Columbus back to the Antilles and acted as his interpreter, and eventually Guarionexius, the King of Cibana (in Hispaniola), in order to secure to himself the friendship of Columbus, gave his sister as wife to Didacus. In most of the islands Didacus appears to have understood the language with ease, and when he failed to do so the fact is expressly stated. This was the case at one end of Cuba.

> But here [writes the old chronicler] Didacus, the interpreter, which understood the language of the beginning of Cuba, understood not them one whit; whereby they [the Spaniards] considered that in many provinces of Cuba were sundry languages.

Who these people were whose tongue was incomprehensible to a Lucayan, who spoke the Arrowauk language, we have no means of judging. As Didacus could not understand these people "one whit," the difference in their tongue from that of the generality of the Arrowauk descendants must have been very great, more so apparently than that of a diversity of *patois* or of accent. This seems

to point to the fact that there were other Indians living in some of the islands besides Arrowauks and Caribs. We know that from time to time Indian traders from the mainland visited the islands, and some of them may have remained and settled in them. On his fourth voyage Columbus met some of these trading canoes, and Peter Martyr gives a detailed account of the event from a letter written by Columbus himself.

Leaving the islands of Cuba and Jamaica on his right hand toward the north, he [Columbus] writeth that he chanced upon an island more southward than Jamaica, which the inhabitants call Guamassa, so flourishing and fruitful that it might seem an earthly paradise. Coasting along by the shores of this island, he met two of the canoes or boats of those provinces, which were drawn of two naked slaves against the stream. In these boats were carried a ruler of the island, with his wife and children, all naked. The slaves, seeing our men aland, made signs to them to stand out of the way, and threatened them if they would not give place. Their simpleness is such that they neither feared the multitude or power of our men, or the greatness and strangeness of our ships. They thought that our men would have honored their master with like reverence as they did. Our men had intelligence at the length that this ruler was a great merchant, which came to the mart from other coasts of the island, for they exercise buying and selling by exchange with their confines. He had also with him good store of such ware as they stand in need of, or take pleasure in: as laton bells, razors, knives, and hatchets, made of a certain sharp yellow stone, with handles of a strong kind of wood; also many other necessary instruments, with kitchen stuff, and vessels for all necessary uses; likewise sheets of gossampine cotton, wrought of sundry colors. Our men took him prisoner, with all his family, but Columbus commanded him to be loosed shortly after, and the greatest part of his goods to be restored to win his friendship.

The Arrowauks were ignorant of the working of metals, so the mention of "laton bells" as part of the stock in trade of this roving trader points to his having come from the mainland, where the Zuñis, Aztecs, Mayas, and Peruvians were all workers of bronze, or laton, though they had not progressed so far as the use of iron.

That the Caribs were later comers in the Antilles than the Arrowauks seems likely from the fact that they had only established themselves in the smaller islands, and made thence raids on the inhabitants of the larger ones; for it is highly improbable that, had so fierce and domineering a people had time to increase and multiply, they would have left their weaker neighbors in possession of all the larger islands, though it is possible they regarded the latter as stock farms whence to draw supplies for their larders. Some authors even assert that the arrival of Caribs in the islands could only have shortly preceded the Columban discovery. The Spaniards were astonished to observe that the Carib women spoke a different lan-

guage from the men. The Caribs did not kill or eat the women whose tribes they attacked. The young women, says Martyr, "they take to keep for increase, as we do hens to lay eggs; the old women they make their drudges." Alluding to this fact, and discussing the probable date of the arrival of the Caribs in the West Indian Archipelago, Dr. D. G. Brinton says:

> The latter event was then of such recent occurrence that the women of the island Caribs, most of whom had been captured from Arowaks, *still spoke that tongue.*

The comparatively mild and inoffensive Arrowauks must have had a bad time of it when the Caribs were on the war path in those lovely islands, about which Martyr writes so enthusiastically as "an earthly paradise," where

> was never any noisome beast found in it, nor yet any ravening four-footed beast: no lion, no bear, no fierce tygers, no crafty foxes, nor devouring wolves. All things are blessed and fortunate,

exclaims he, writing of Hispaniola; but the human enemy, more relentless and deadly than four-footed beast, must have been a blighting factor in the happiness of the daily life of the Arrowauk, even before the arrival of Spanish oppressors. "They of the islands," writes the old monk, ignoring his having pronounced all things there "blessed and fortunate,"

> when they perceive the cannibals coming have no other shift but only to flee, for although they use very sharp arrows made of reeds, yet are they of small force to repress the fury of the cannibals, for even they themselves confess that ten of the cannibals are able to overcome a hundred of them if they encounter with them.

Cruel as were the Spaniards to the unfortunate Indians in general, to the Arrowauks they must at first have appeared almost as benefactors compared to the Caribs, and indeed the more severe enactments of the conquerors were avowedly directed against those Indians "guilty of that unnatural crime" of eating human flesh.

Nowadays that travelers in Africa, New Zealand, the Pacific, and elsewhere have made us familiar with stories of cannibalism as a widespread practice among savage peoples, and that research has shown us that in prehistoric times it may not have been unknown even in Europe, we often fail to appreciate the horror and astonishment with which so strange and revolting a habit filled the early Spanish navigators. It came upon them as a shock, a horror which was a novelty, and therefore all the more abominable. We are always apt to overlook cruelties and evils with which we are familiar, while rarely failing to be scandalized at those that are new to us. The Spaniards were not squeamish about cruelty, and indeed the

word can not be applied to cannibalism, for once a man is dead it is not more cruel to eat his body than to bury or burn it.

The Inquisition had made the Spaniards callous to barbarity, but cannibalism was a different matter; they were not accustomed to it, had never before met with it. Rough sailors, relentless bigots as they were, who at home doubtless would have attended a bullfight or an *auto-da-fe* with equal pleasure, they could not stomach cannibalism, and it was with loathing and unspeakable disgust that in the round, bell-like houses of an Indian village they often found

in their kitchens man's flesh, duck's flesh, and goose flesh, all in one pot, and other on the spits ready to be laid on the fire. Entering into their inner lodgings, they found fagots of the bones of men's arms and legs, which they reserve to make heads for their arrows, because they lack iron; the other bones they cast away when they have eaten the flesh. They found likewise the head of a young man fastened to a post, and yet bleeding.

By the people supposed to be of Arrowauk descent the Spaniards were generally received with submission and fear, the people mistaking them for Caribs, except in a part of Jamaica, where the inhabitants at first offered a feeble resistance. In some instances the new arrivals were even worshiped as gods. Such was the case in the Bahamas and in Haiti, where ancient prophecies had taught the Indians to expect the arrival of

Maguacochios—i. e., men clothed in apparel, and armed with such swords as should cut a man in sunder at one stroke, under whose yoke their posterity should be subdued.

The existence of these prophecies seems not to have excited any great surprise or to have caused much speculation as to their origin in the minds of the Spaniards. Such apparently miraculous foresight on the part of the Indians the new arrivals easily, and to themselves satisfactorily, accounted for by the fact that the barbarians were worshipers of the Evil One, and that their priests and idols, or zemis, were enabled to prophesy because of their intercourse and familiarity with devils. But, notwithstanding much that was objectionable and false, the creed of the Indians does not appear to have been altogether debased, and as explained to Columbus by one of the old chieftains of Cuba, the doctrines of those remote and benighted savages might claim some affinity to those professed by the Christians. Columbus and his men had landed and were hearing mass on the Cuban shore when "there came toward him a certain governor, a man of fourscore years of age, and of great gravity, although he were naked," and who

had a great train of men waiting on him. All the while the priest was at mass he showed himself very humble, and gave reverent attendance with grave and demure countenance.

When mass was over the old chief "presented to the admiral a casket of the fruits of his country, delivering the same with his own hands." After Columbus had "gently entertained him," the old man made a speech, which Didacus, the interpreter, translated to the Spaniards to the following effect:

I have been advertised (most mighty prince) that you have of late with great power subdued many lands and regions hitherto unknown to you, and have brought no little fear upon all the people and inhabitants of the same: the which your good fortune you shall bear with less insolency, if you remember that the souls of men have two journeys after they are departed from this body. The one, foul and dark, prepared for such as are injurious and cruel to mankind; the other, pleasant and delectable, ordained for them which in their lifetime loved peace and quietness. If therefore you acknowledge yourself to be mortal, and consider that every man shall receive condign reward or punishment for such things as he hath done in this life, you will wrongfully hurt no man.

Columbus,

marveling at the judgment of the naked old man, answered that he was glad to hear his opinion as touching the sundry journeys and rewards of souls departed from the bodies, supposing that neither he or any other of the inhabitants of those regions had had any knowledge thereof; declaring further that the chief cause of his coming thither was to instruct them in such godly knowledge and true religion . . . and especially to subdue and punish the cannibals and such other mischievous people, and to defend innocents against the violence of evildoers, etc.

The old man was so pleased with these comfortable words of the admiral that he became desirous of forsaking Cuba and accompanying Columbus to Spain, "notwithstanding his extreme age," and was with difficulty deterred from the purpose by his wife and children, who fell prostrate at the feet of the old cacique, imploring him with tears not to forsake and leave them desolate.

At whose pitiful requests the worthy old man, being moved, remained at home, to the comfort of his people and family, satisfying rather them than himself; for, not yet ceasing to wonder, and of heavy countenance because he might not depart, he demanded oftentimes if that land was not heaven which brought forth such men.

The Caribs were of different mettle from the inhabitants of the larger islands. They resisted to their utmost, and sometimes, without waiting to be assailed, attacked the Spaniards even at sea. In the Gulf of Paria we read that the Spanish vessels met with

a navy of eighteen canoes of cannibals, which went a-roving to hunt for men, who, as soon as they had espied our men, assailed their ship (that of Petrus Alphonsus, called Uignus) fiercely, and without fear inclosed the same, disturbing our men on every side with their arrows.

But, courageous as they were, the novel terror of the flash and smoke and thunder of the guns struck consternation into the daring cannibals, who turned and fled before the unexpected and alarming fire and fury of the cannon. The Spaniards gave chase and captured one of the canoes; in it was only one Carib; his companion or companions had escaped, but in the piragua lay a captive tied and bound, who, with tears running down his cheeks, made the Spaniards understand by gestures that six of his comrades had already been killed and eaten, and that such was to have been his own fate on the following day. The Spaniards unbound the prisoner and

gave him power over the cannibal to do with him what he would. Then, with the cannibal's own club, he laid on him all that he might drive hand and foot, grieving and fretting as it had been a wild boar, thinking that he had not yet sufficiently revenged the death of his companions when he had beaten out the brains and guts.

Speaking of the Caribs of the mainland, the old writer says: "That wild kind of men, dispersed through the large distance of those coasts, hath sometimes slain whole armies of the Spaniards." Indeed, the Caribs even mocked at their invaders, designating them as women or children, in ridicule of their white teeth, those of the Caribs "being black as coals, from a leaf they chewed."

The Arrowauks were taller than the Caribs, but not so robust, in color of a clear brown, their complexion, according to Columbus, not being much darker than that of a Spanish peasant. Both Arrowauks and Caribs flattened their heads, though each race had a different fashion of doing so.

By this practice [says Herrera] the crown was so strengthened that a Spanish broadsword, instead of cleaving the skull at a stroke, would frequently break short upon it.

Various reasons have been assigned for the singular fashion of flattening the head that obtained throughout the Antilles. It is said that infants whose heads are so treated do not cry or moan as do babies whose heads are left to Nature; but if, as some anatomists affirm, the coronal sutures in the heads of infants born in the West Indies are exceptionally open, the strengthening of the skull was probably the reason that had originally brought flattened foreheads into fashion. The practice, it is believed, does not lessen the intelligence of the bearer of the flattened head, and if it has any effect on the brain it would be in the direction of subduing "speculative and emotional energy," while developing activity of limb. Their hair, like that of Indians in general, was straight, coarse, and black; their features were hard and ugly; they had broad faces and flat noses, but their eyes showed great good nature, and their countenances were open and pleasing.

It was an honest face [says Martyr], coarse but not gloomy, for it was enlivened by confidence and softened by compassion.

Their wants were few, and sea and land furnished them with the necessaries of life, without exacting any severe or continuous labor on their part; so, as is almost invariably the case with natives of the tropics, the Arrowauks were indolent and indisposed to hard work, though showing considerable energy in their amusements, as we are told that "it was their custom to dance from evening to dawn." Another of their favorite pastimes was the game of *bato*, said somewhat to have resembled cricket. The players were divided into two sides, which alternately changed places. The ball with which they played was made of India rubber from the native milk withy, and the elastic nature of the material was a surprise to the Spaniards, who heretofore had not seen India rubber. Both men and women took part in the game; the ball was not caught with the hand, but received on head, elbow, or foot, and repelled with great force and dexterity. Wrestling and running for prizes were also well-known amusements among these people.

The great defect of the Arrowauks was their extreme immorality. Some of their dances were exceedingly indecent and disgusting, and the more abandoned a woman was, the greater was the consideration in which she was held. The religions and beliefs of the Indians varied more or less with the different tribes and races among them, and no doubt the Arrowauks had a variety of sects and formulas in the different islands. In broad lines we gather that they believed in a supreme being called Jocahuma, who had a father and mother residing sometimes in the sun and sometimes in the moon. Divine honors were also paid to images of wood, stone, and cotton, called zemis, which represented usually distorted versions of the human face and sometimes reptiles. A consecrated hut or temple was set apart in every village for worsip of these zemis, but only the priests or Bohitos were permitted to enter these temples, and they acted as intercessors for the people, besides practicing the art of medicine and superintending the education of the children of caciques and men of high rank. When the will of the cacique had received the approval of the Bohito or priest, it was received by the people as the decree of Heaven.

The spirits of the good were believed to go to a pleasant valley called Cozaba. There, surrounded by leafy trees laden with delicious fruits, the islanders looked forward to rejoining the spirits of their ancestors, and in cool shade beside flowing rivulets to rejoice in the society of the friends they had loved in the islands of earth, in a land where there were no hurricanes, no drought, and no Caribs. Each tribe appears to have considered that this paradise was situated

in some mysterious way within their own province. During the day the souls of the departed hid themselves in the fastnesses of the mountains, but in the soft, fragrant tropical nights the souls were said to emerge from their retreat and to come down to the valley, to feed upon the fruit of the glossy-leaved mammee. This tree was consequently deemed sacred by the Indians, who refrained from eating the fruit lest the spirits of their ancestors might want food.

Of course, there were many variations in the rituals and beliefs of the religions of the various tribes. It would be as impossible to attempt an account even pretending to be comprehensive of their creed, in the space of a few pages, as it would be to do so of the churches and sects of Christianity; but such, in broad lines, is the sketch left us by the Spanish writers of the faith of the peoples of the Greater Antilles. Accounts of creeds given by opponents of the religion are, of course, always liable to misconceptions and perversions. The Indians, on their side, seem often to have been under the impression that the object worshiped and invoked by the Spaniards was gold, and not the Trinity. Gold they already regarded with a certain reverence, apparently esteeming it a sacred thing, as before setting out to seek for it they underwent a certain course of abstinence and fasting.

Hatuey, a cacique of Santo Domingo, had emigrated thence with his people to Cuba, in order to escape from the tyranny of the Europeans. The Spaniards pursued the fugitives, and the cacique exhorted his followers to resist to the uttermost, but pointed out to them that no bravery of theirs could prevail unless they invoked and conciliated the god of the Spaniards, who had shown himself to be so powerful, and in whose honor their enemies were ready to embark on any enterprise.

> Behold him [exclaimed Hatuey, showing his men a basketful of gold], behold that god for whom they undertake so much; it is for him they came here. Let us, then, celebrate a feast in his honor, to obtain his protection.

Thereupon the Indians began their sacred songs, all the while dancing around the gold. Hatuey, however, declared that they could not be safe so long as the god of the Spaniards remained in their neighborhood, and that he should be buried where he could never be discovered. Amid shouts of joy from the people the gold was then cast into the sea. But, unfortunately for the Indians, his power was not so easily allayed as that of their zemis. The Spaniards came, the cacique fell into their hands, and was condemned to be burned alive. As he was being tied to the stake a Franciscan friar drew near and attempted his conversion, telling Hatuey of the heaven and hell of the Christians. "In this place of happiness

whereof you speak," said the cacique, "are there any Spaniards?" "Assuredly," answered the missionary, "but only good ones." "The best of them were good for nothing," replied Hatuey, "and I desire not to go where I may be in danger of meeting with one of that horrid tribe."

"Les grands mangeurs de viande sont en général cruels et féroces, plus que les autres hommes; cette observation est de tous les lieux," writes Rousseau, and the difference in the disposition of the Arrowauks and Caribs bears out the truth of the remark. The Arrowauks had little animal food, with the exception of fish, a few birds, reptiles, and insects; but the Carib larders were kept well furnished with human flesh, and even if an expedition had failed to bring back men prisoners for the table (women were not eaten), they had preserves of children taken in former raids, and fattened up till they were plump enough to be irresistible to any cannibal palate.

But though on festival occasions they no doubt gorged themselves both with meat and drink, as a rule, like Indians in general, they were very abstemious. Indeed, the Spaniards, although the most abstemious of Europeans, to the Indians—"whose abstemiousness," says an old writer, "exceeded that of the most mortified hermit"—appeared excessively voracious. So surprised were they at the appetites of the Spaniards—one of whom was supposed to consume as much as ten Indians—that the islanders were of opinion that the Spaniards must have come among them in quest of food, their own country not producing enough to satisfy such immoderate appetites—a conclusion which Carib manners and customs would certainly assist in forming.

Both Arrowauks and Caribs were fond of smoking. They intoxicated themselves with tobacco, which they called cohiba, drawing up the fumes by a tube through the nostrils. A dream coming during the ensuing intoxication was regarded as an inspiration.

Though usually shorter than the Arrowauks, the Caribs were strong and muscular, active and lithe. To our eyes their appearance would have been anything but pleasing. In their cheeks and ears they made deep incisions, which were rendered conspicuous by being stained black; their faces and bodies were painted red with annotto, and round their eyes they were distinguished by circles of black and white. Some of the greater dandies pierced the cartilage of the nose, and inserted therein the bone of a fish, a piece of tortoise shell, or a parrot's feather. Instead of shells they strung together the teeth of their enemies slain in battle, whenever such could be obtained, and wore them round their arms and legs. Their arrows were usually poisoned, and when attacking an enemy by night the arrows were often tipped with cotton dipped in oil and set alight, in

order to fire the dwellings they assailed. When a male child was born it was sprinkled with some drops of the father's blood, and as the child grew older it was if possible anointed with the fat of a slaughtered Arrowauk. When the boy entered manhood he had to undergo excruciating tortures in order to prove his prowess and claim to be accounted a warrior. They were not unskillful in the few arts with which they were conversant; they wove cotton and dyed it of various colors, red being the favorite color of the Caribs; they made pottery and burned it in a rough kiln, the shapes of some of their vessels being artistic and pleasing. They were particularly clever in weaving baskets of palmetto leaves, an art still retained by the Caribs of Dominica and St. Vincent, whose beautifully dyed and woven baskets are fashioned with such cunning that they will even hold water. Like the Arrowauks, they believed in future states of bliss or woe. In the former the braves were to enjoy supreme felicity with their wives and captives, while the spirits of cowards were to be banished eternally beyond the mountains, and doomed to everlasting toil in captivity to the Arrowauks. In every hut there was an altar made of banana leaves and reeds, on which they placed the earliest fruits and choice viands. Demons and evil spirits were dreaded and worshiped, and sacrifices offered to them by the hands of their Boyez, or magicians, the worshipers on such occasions wounding themselves by instruments made of the teeth of the agouti.

We can picture the depredations caused by the incessant marauding of bands of these ferocious cannibals, and the terror they must have excited in the minds of the milder islanders. Peter Martyr tells us that in his time alone more than five thousand men had been taken from the island of Sancti Johannis to be eaten. Even after the Caribs had abandoned cannibalism they continued a fierce and desperate people, shunned and dreaded by Arrowauks and Europeans alike, and when cannibalism had ceased to be an everyday matter it would break out every now and then when occasion arose. The establishment of Spanish rule and the disappearance of the Arrowauks must have been the main factors in the decline of cannibalism, but before such was the case the Caribs seem to have given up the practice in some places. Thus Herrera says that "those of St. Croix and Dominica were greatly addicted to predatory excursions, hunting men," but not long before he wrote the Caribs of Dominica had eaten a poor monk, "and he so disagreed with them that many died, and that for a time they left off eating human flesh, making expeditions instead to carry off cows and mares."

When the English began to settle in the smaller Antilles they found the still unconquered Caribs a formidable obstacle to their

peace, and they must have been a difficulty to be reckoned with till the close of the seventeenth century at least.

It is difficult to judge what were the number of the inhabitants of the islands at the time of the discovery. In 1495, when the Indians of Hispaniola rose against Columbus, according to the Spaniards, the number who revolted was a hundred thousand. Some authors place the native population of Hispaniola as high as three millions. It must have been impossible for the invaders to have formed any accurate computation of the number of inhabitants in countries so mountainous and impenetrable as were the larger Antilles. However, all accounts agree that the Indians were very numerous, and Las Casas describes the islands as "abounding with inhabitants, as an anthill with ants."

It seems extraordinary how so numerous a people could have been exterminated in so comparatively short a time. Oppression and cruelty alone could not have succeeded in wiping them out so completely. The Caribs were treated with greater severity than the Arrowauks, and their numbers were small in comparison with their less warlike neighbors, and yet the race survives to this day in Dominica and St. Vincent. Probably there was an inherent weakness in the race itself that tended to its destruction. They were timid and vicious, and timidity and vice are qualities that must hasten the disappearance of any people. Famine and disease seem to have been the chief factors in blotting out the Arrowauks. In Hispaniola the Indians, hoping to rid themselves of the voracious Spaniards, refused any longer to sow any crops. The Spaniards do not seem to have suffered as was expected, but in a few months no less than a third of the number of Indians in that island are said to have perished from starvation. But in 1518, according to Herrera, a scourge appeared in the Greater Antilles that almost desolated them. We know how great are the ravages of any imported disease among barbarians.

In our own days the natives of Fiji were swept off in thousands by so comparatively mild a distemper as measles: we can therefore understand how terrible must have been the ravages of so fatal an illness as smallpox, which was then first introduced from Europe. Even at the present day it is dreaded, but at that time it was twenty times more deadly and dreadful than now. The Indians were swept off in crowds, and the islands were almost depopulated. The mortality was increased by the miserable sufferers flinging themselves into the streams and rivers to seek relief from the burning fever that consumed them. Granting that the great majority of the Indians succumbed from disease and famine, the remainder of a people deficient in stamina might easily have dwindled away under the conditions then existing. Labor was odious to them, and that in the

mines proved very fatal. The pearl fisheries also caused much mortality. These were chiefly worked by Indians from the Bahamas, who were expert divers and able to remain long under water; but so little care was taken of the men that they gradually died off, and, as the Bahama Islands had been entirely depopulated, it was impossible to supply their places.

Of course, the cruelty experienced from their conquerors was one among other causes of the disappearance of the Arrowauks, but if the Indians were so numerous, it would be contrary to experience that oppression alone would so soon have exterminated such a multitude, in islands of such considerable area and so inaccessible to invaders.

THE FOREIGN ELEMENT IN AMERICAN CIVILIZATION.

By ARTHUR HOUGHTON HYDE.

THE history of the United States, more than that of any other nation, is a history, not of wars and dynasties, but of the progress of a people. In the early days of British dependency the population of the thirteen original colonies comprised representatives of several diverse races, many of whom had sought the inhospitable shores of a new land to gain religious liberty, others to better their worldly condition, some under compulsion, yet all these heterogeneous elements became for a time amalgamated, animated with one desire and purpose—liberty, freedom from what they considered the unjust exactions of the English Government. This country occupies a remarkable position among the nations of the world; although its early citizens were principally of the so-called Anglo-Saxon race, yet there was among them a plentiful sprinkling of representatives from the Teutonic, Latin, and Celtic nations. Even in the days of its genesis it probably possessed a more heterogeneous population than any other country of the earth, and during the century and more of its development the foreign element has been an ever-increasing quantity among the inhabitants, until now we find that 14.77 per cent of the entire white population is foreign born, and 22.74 per cent more of foreign parentage. It is for these reasons a matter of some wonder that its historians have not paid more attention to the ethnic and racial composition of the population, and endeavored to ascertain what modifications these factors have produced.

Never have I found a finer appreciation of the true importance of the ethnic factor than in a recent article by Raoul de la Grasserie, in which occur passages translated as follows:

"The ethnic character has a profound influence on the choice between the two modes of government. With some peoples, individual autonomy—independence of character—is strongly traced; for example, among the Germanic nations. Each one engages only his extreme exterior in society. With nations of such temperament, family life is strongly developed; the *home* is a sacred ark. . . .

"With some other peoples—with the Latin nations in general—it is quite different; the autonomy is less refractory; they like to live in society, and prefer to discharge the functions of thinking and wishing upon others. . . . The will not being carefully cultivated, it diminishes, and the state acts for the individual.

"It is not the race alone that has influence in this matter, but many other factors—climate, soil, religion, and time; usually all these concur in giving direction." *

Nevertheless, the writer fails to reach important conclusions logically deducible from his premises, although the diverse racial composition of the nations of Europe, where it is an almost unvarying factor, can scarcely be brought into analogy with the same phenomenon in America, where it is constantly changing.

American civilization can scarcely be regarded as a native product, for it did not slowly grow up upon the soil, but was transplanted by the earlier settlers from European shores early in the seventeenth century. The progress of civilization is largely due to the evolution of thought, the passage from the less to the more complex—from the homogeneous to the heterogeneous, the advance in religion, science, art, literature, liberty, which are themselves again all interdependent upon the primal factor, the evolution of thought.

Many conditions were then favorable to a rapid advance in American civilization: the colonists were in most cases men of some education, their minds were imbued with the principles of liberty, and the early fanaticism which characterized the religious refugees gradually disappeared under the influence of the new life. In Pennsylvania, which in its conception was planned as a refuge for all persecuted for religion's sake, where the greatest freedom of mind and person was enjoyed, we discover that civilization progressed most rapidly, a progress which placed her at the head of all the other colonies until the beginning of the nineteenth century. What effect, then, we must ask, has the foreign element had upon American thought, and incidentally upon the material resources of the country. To the former question history vouches no reply, and even to the latter no satisfactory answer is afforded. It is true that many writers have attributed the rapid increase of the population to the immigra-

* Revue internationale de Sociologie, vol. iv, p. 888.

tion movement, and this proposition, while it has been generally accepted, must be relegated to the already long list of popular prevailing fallacies; and although this movement may have been responsible for a slightly larger aggregate increase than if the natural increase had alone prevailed, it can scarcely be considered an important factor.

It is a well-known law of population that, other things being equal, the rate of natural increase of population varies in an almost inverse ratio to its density, so that as the density of the population was increased by the addition of aliens, the rate of natural increase declined, which is demonstrable from statistics furnished by the census records of this country.

Prior to 1830 the foreign arrivals constituted far less than five per cent of the entire increase, yet it was during the period from the close of the Revolutionary War to that year that the entire rate of increase was the greatest, and we witness from that time a steadily declining rate of aggregate increase and a steadily advancing rate of increase of alien arrivals; thus in the decade ending 1840 the foreign element constituted ten per cent of the entire increase, in 1860 it had risen to thirty-two per cent, and in 1890 to forty-five per cent, and while the action of the law may be slightly disturbed by the varying fecundity of the different nationalities among the alien immigrants, yet this disturbing factor is in part equated by the larger mortality usually prevailing among children of parents belonging to those races marked by the greatest fecundity.

It is my purpose in the following pages to briefly trace the immigration movement, and outline the more important developments in the nation's progress attributable to it. The early citizens of this country were, as in every other new state, a hardy race, inured to toil, unaccustomed to luxury, with little scholarship and less wealth; but with this addition, every white man was actually as well as theoretically the peer of every other citizen. There was no dominant class; there were few servants except the slaves.

Scarcely had peace been declared when the immigration movement began again, but it was not extensive, and up to 1810 the alien arrivals in this country varied from four thousand to six thousand annually. In that year, however, unfriendly relations, followed by war with Great Britain, for a time put a stop to this movement; but in 1815, a state of amity again prevailing, it resumed with increased vigor. Among the immigrant arrivals in these early days we find a large proportion of agriculturists, mechanics, and skilled laborers; the trouble of 1798 drove many of the ablest Irishmen hither, and the immigrants were usually the more intelligent and ambitious members of the middle classes. The British journals, in 1815, com-

plain of "the ruinous drain of the most useful part of the population of the United Kingdom," and that universal panacea for all ills, social and otherwise—parliamentary action—was demanded. The skilled craftsman upon his arrival found positions of responsibility awaiting him; the native inhabitants did not have any considerable knowledge of the mechanical arts, and it therefore devolved upon the foreigner to take the position which the American was incapable of filling. The school teachers were largely recruited from the ranks of the alien; early in the century all the booksellers but two in Philadelphia were foreigners, and of the five newspapers in that city two were owned by Englishmen and two by Irishmen. With these desirable immigrants, however, began to come another class, poor and ignorant, having neither trade nor money; they became stranded in the seaboard towns, being without the means to proceed farther; some became laborers, others earned a precarious livelihood by doing a little work at intervals, but many finally became dependent upon public charity. Then it was that the delinquent classes, paupers, and petty criminals, arose and multiplied rapidly for the first time in the history of the country.

This evil might have then been almost eliminated from the population, or at least materially abated, but unfortunately the great city of Philadelphia at that time, when it most demanded prompt suppression, fostered it by well-meant but indiscriminate charity, which of course resulted in the rapid growth of a dependent and semi-criminal class. It is almost needless to point out that social evils may spread as rapidly as diseases of the flesh, and that the moral contagion is much more difficult to eradicate than the physical; and it will therefore occasion no surprise to find that pauperism and crime communicated themselves to the native element. Yet in no community exhibiting the complex organization that did this country at the beginning of the nineteenth century would an escape from this evil have been possible; the hour of its arrival might have been somewhat postponed, but the very fact of the rapid spread of the contagion is an indication of the unhealthful condition of the social fabric; of this, too, we have further evidence in the incipient rebellions which began almost immediately after the Revolution was over, and manifested a restlessness and impatience, largely on the part of the native American element, and a dissatisfaction with constituted authority.

Here a distinction is to be drawn between the development of the North and the South, and, as the latter presents few complex features and can not occupy much of the space of this article, it may as well be dealt with here. Of the original colonies, those south of the thirty-seventh parallel seem to have never attracted many aliens,

although for a time in the early part of the century Alabama appears to have been a popular focal point with emigrants both from the older States and from abroad; yet this was one of the richest sections of the country, abounding in natural resources, and would have ordinarily afforded a livelihood with much less expenditure of energy than would the territory farther to the north. Perhaps the general disinclination on the part of natives of the temperate zone to settle in warm climates may have been in slight degree responsible for this state of facts, but there can be little doubt that the institution of slavery was a more serious detriment to the advancement of the South than any other cause. There had begun to grow up there an aristocracy as exclusive and as proud as that of any state in Europe, and which, in fact, dominated the whole section; the agricultural operations were carried on principally by slaves, and the landowners lived in a kind of feudal state, surrounded by a large body of dusky retainers; the remainder of the white population were poor and ignorant, exercised little more influence than did the negroes, and were looked down upon by both blacks and whites alike. Work was regarded as degrading and beneath the dignity of a gentleman, and strangers proposing to establish themselves there were looked upon with a jealous eye. All these circumstances were highly unfavorable to the establishmnt of new industries and to its industrial progress. There were no mines and manufactures, because there was no one with sufficient knowledge to conduct the operations.

We find that early in its history a certain stage of civilization was reached, for a time and in one way in advance of that of the North, due to the creation of a leisured class, but, being reached, there was no further advance, and for nearly half a century no progress was made. The war of secession and the concomitant abolition of slavery brought about in a few short years what it had taken centuries in Europe to accomplish: a hereditary servient class was raised to an equality—political and theoretical at least—with a hereditary dominant class which was by the same force rendered almost penniless. This may have proved the salvation of the South, but for a time a black pall of misery and degradation settled down upon it. There were no industries to revive, there was no all-powerful middle class; the aristocracy had been ruined, and between the two extremes there was no mean.

About the close of the first quarter of the century we discover that a servient class had also begun to be created in the North, but it was entirely distinct from that of the South; the services of its members, most of whom had sought a new world with the ulterior object of bettering their condition, were given voluntarily and for wages. A dominant class in the present condition of society appears to be neces-

sary to the higher advances in arts and material prosperity, and with the creation of a servient class which was composed principally of aliens, a dominant class inevitably arose, which may be numbered among the earliest contributions of the foreign element to American civilization.

In 1812, at the commencement of the second British war, the state found itself in a most depressed financial condition; national and individual ruin were freely predicted, an extensive westward movement began, and that great central section of the country lying between the Ohio River and the lakes, the Mississippi and the Appalachian Mountain system, then almost a *terra incognita*, commenced to receive large increments in population from among these pessimistic Easterners. What the result would have been had these gaps in the population of the New England and Middle States not been filled within a few years by aliens it is hard to discern; possibly the development of this section might have been slightly delayed, although not by any means necessarily so, as a diffusion of the then existing population would otherwise inevitably have followed, doubtless with beneficial results. But it is unnecessary to here speculate upon something which never happened.

These earlier immigrants to the country were, as we have already seen, largely of the better class of mechanics and skilled laborers. The farmers constituted about a sixth of the entire alien arrivals, and the remaining five sixths usually found occupation in the towns; in fact, the growth of the urban population is closely identified with the immigration movement. In 1790 the urban population constituted but three and a third per cent of all the inhabitants, and there were only six cities with a population in excess of eight thousand; in the decade between 1810 and 1820, when, as already noted, there was a large westward movement and a decrease in immigration by reason of the war, the percentage of urban inhabitants remained unchanged, but otherwise it has increased in an almost constant progression until the decade from 1880 to 1890, during which the rate of progression advanced considerably.

The first definite statistics which we have of the immigration movement begin with the year 1820, when we find the Irish element largely predominating over all other arrivals; it is regrettable that we can not distinguish the north Irish and the south Irish, as they may be regarded as widely variant factors. It was from among the latter that the servient class—day laborers, domestic servants, etc.—was drawn, and it was also largely from among them that the delinquent classes were recruited. In 1830 the German aliens began to constitute a considerable factor among the arriving immigrants, being in excess of those from Great Britain, but the Irish continued in the

preponderancy until 1854, when they were surpassed by the Germans. The year 1847 marks the beginning of an important epoch in the history of immigration; during this year the foreign arrivals numbered 234,968, and in 1849 the number had risen to 297,024; then it advanced with startling rapidity to 460,474 in 1854, and in the following year fell off just one half. This movement was induced by three causes: the Irish famine, commercial depression in Germany, and the discovery of gold in California. That this was in part a "boom movement," and that many of the immigrants returned to their homes nourishing disappointed hopes, can not be doubted, yet, while a large number of these arrivals formed no permanent element in the American state, they served a purpose by opening up the great region to the west of the Mississippi, a land at that time almost unknown except to a few native American pioneers; in fact, it becomes apparent that in every new and unexplored section the native Americans constituted the advance guard of civilization, leaving the foreigners to come in later, when the primeval wilderness was but a tale of the past. During this period of a little over six years there crossed the borders into this country over two and a quarter millions of persons, at a time, too, when the entire population did not exceed 23,200,000; and of these alien arrivals fully eighty per cent were from Ireland and Germany. Twice have the arrivals from Germany overbalanced those of all the English-speaking people: once in 1867 to 1868, and again in 1881 to 1885. Shortly after the middle of the century the arrivals from Ireland and those from Great Britain approached an equality, and in the year 1868 the Scandinavian influx began. In the decade between 1880 and 1890 three new elements, the Russian, Austrian, and Italian, also began to arrive in considerable numbers. Since the Revolution, the English-speaking immigrants entering this country have preponderated over all others, having reached a total of 8,016,402,* † almost half of whom were Irish; those from the United Kingdom alone have numbered 6,964,815; † the arrivals from Germany have been 5,003,490; † from Scandinavia, 1,192,131; † from Russia, 749,039; † from Austria, 821,663; † and from Italy, 818,011.† But while the movement from the latter countries is increasing, that from those first mentioned shows signs of diminution. From China over 300,000 persons have arrived, and from France, 388,000, but

* Since July 1, 1885, no record has been kept of immigrants from British North America.

† These returns are corrected to September 30, 1897. The figures include all alien passengers to December 31, 1867, and immigrants only from that time to the first-mentioned date. Prior to 1820 no records were kept of the immigrant arrivals, and my estimate can be only approximately correct.

the principal movement from that country was prior to 1860, and is perhaps attributable largely to the political unrest there prevailing in the early years of the century. The total immigration has amounted to 18,476,726,* the greater proportion of which have been males between the ages of fifteen and fifty years.

Previous to 1828, few children under the age of fifteen years arrived, but after this year there was a distinctive increase in the family as distinguished from the individual movement. The family movement has been much greater among the British than among the Irish—which people present the anomaly of the female emigration being generally equal to and in some years in excess of the male—but is most marked among the Germans and Austrians; † while, on the other hand, from Scandinavia, Switzerland, and the Mediterranean countries of Europe it is an unimportant factor. In the case of Russia, however, a family movement of some magnitude seems to have prevailed.

Great Britain, as might be expected, has furnished more skilled craftsmen, clerks, etc., than any other country. The greatest number of farmers ‡ has come from Germany, but Scandinavia has also furnished an appreciable proportion. From Ireland have come more unskilled laborers and servants than from any other country, although Germany is a close competitor. Since the middle of the century, and even more markedly since 1880, the status of the arriving body of immigrants has, altogether, vastly deteriorated. The swarms of aliens who are generally classified as "without occupation," arriving from Italy, Poland, and Hungary, have enormously swelled this total. While it is true that the immigration statistics show a considerable number of farmers * from Russia and Italy, yet these rarely continue their original occupation upon arriving in this country; in fact, a large number of them ultimately come to constitute the refuse population of our great cities.

That the foreign element has exercised an effect observable in visible and tangible results can not be doubted; it was primarily the effect of training by foreign craftsmen that the native workers have arrived at the degree of proficiency in arts, manufactures, and all industries which now distinguish them. Many aliens have fought by land and by sea in the wars in which this country has been engaged; aliens have had command of its fleets and its armies; sev-

* See note (†) on page 393.

† Not including the Hungarians, among whom the proportion is very small.

‡ The word farmer is used synonymously with "agricultural laborer," as employed in the reports of the Commissioner of Immigration, although as a matter of fact many of those so classed have scarcely a knowledge of the rudimentary principles of farming, and would be incapable of conducting the most ordinary agricultural operations.

* See above note.

eral of the most distinguished names in the annals of American achievement claim a foreign birthplace. But must we stop here—is this all that the foreign element has done for American civilization? If so, the debt of the United States to the stranger is not great, and immigration may with good cause have restrictions placed upon it.

Scarcely were the American colonies founded when the anti-immigration sentiment began to develop. The colonies of New England and, to a lesser degree, Virginia looked with suspicion upon aliens arriving upon their shores, and for a time almost inhibited the movement. Pennsylvania and New York, on the other hand, encouraged immigration, and their more rapid progress over the first-mentioned must be generally admitted, although other factors in their advancement entered into the consideration which space will not here admit of being dwelt upon. Again, this anti-immigration sentiment has manifested itself almost continuously since 1790, sometimes actively, sometimes almost dormant, but never entirely disappearing. We have the results in the Chinese exclusion act, in the various laws now in existence imposing restrictions upon it, in the various laws now proposed, creating an educational test. Whether these measures, actual and prospective, are good or baneful I do not purpose to discuss, but shall pass to a cursory review of racial traits.

We find on comparison that a far greater proportion of the delinquent classes are found among the inhabitants of foreign birth than among those of native ancestry, and even those born in this country of alien parents furnish a larger ratio to these classes than those of purely American parentage. Of the three great elements in the foreign population represented by the Teutonic, the Celtic, and the so-called Anglo-Saxon race, the proportionate numbers furnished to these classes by the Celtic race exhibit a remarkable predominance over either of the others, and this excessive defectiveness, we discover, also extends to the offspring of Celtic parents. The Britons and Germans show little variance from each other in their contributions to these classes, and the Scandinavians exhibit a slightly higher percentage in such contributions over the two last mentioned. The other nationalities represented in the population can scarcely with fairness be drawn into the comparison on account of the recent date at which they have begun to arrive in any considerable numbers; nevertheless, the records of our criminal courts contain the names of many Italians, and already the Hungarians and Poles, the most miserable and degraded representatives of the Caucasian race who cross our borders, are largely numbered among the dependent classes. We have also to notice in these classes a much greater

proportion of females to males among the foreign than among the native element. Havelock Ellis, too, has observed that the criminal instinct manifests itself with much greater frequency in the Irish woman in Great Britain than when at home, and suggests that it is due to a removal of domestic influence; his theory may perhaps be accepted as a partial explanation of a like phenomenon in this country. It is a well-recognized sociological fact that crime is much more prevalent where large aggregations of men are herded together than in the country districts, and this also must be considered in correlation with the further fact already noted that the alien population is much more largely urban than the native.

Mr. S. G. Fisher, in his work, The Making of Pennsylvania, says: "As shown by statistics, the Germans in America, in proportion to their numbers, have produced fewer remarkable and prominent men than any other division of the people. The race itself is not deficient, but when it isolates itself in an American community it is cut off from the best development of that community, and also from its old associates in Europe, and inevitably deteriorates." Elsewhere he remarks that they are difficult of assimilation. That these statements are in part well founded may not be questioned. And with the increasing homogeneity of a people a deterioration, or at least a check to advancement, must inevitably follow, as I have already pointed out in the case of the South. But we have rid ourselves of the notion that great men make history; great men may hasten or retard a movement, but it is the larger, invincible force of popular will which to-day moves the political and social world; which has always moved it, and always will move it. It took the peasantry of Europe ten centuries to shake off the thrall of serfdom. In the eighth century no man, however great, could have freed the serfs; in the fourteenth, no man, however great, could have restrained the flow of liberalizing sentiment. The mills of God may grind slowly, and also exceedingly small; but "with patience he stands waiting, with exactness grinds he all."

The Germans form one of the best elements in the American community; clannish they may be, given to herding together, and yet, although frequently on the surface Germans even to the second and third generation, retaining forms and ceremonials of the fatherland, they are, in fact, readily assimilable. They become assimilated through American influence, newspapers, literature, society, business, and in the second generation through American birth and education, and become true Americans at heart. Their love for the fatherland has been transferred in even greater intensity to their foster land.

I have already noted the fact that the largest proportion of our

delinquent classes is derived from the Celtic element. The Irishman is practically a man without a country; he owes an ill-rendered fealty to the British crown until he leaves his native island and swears allegiance to the American Government, but the oath rests lightly upon him; all the patriotism which he possesses is centered in that ill-starred rebellious dependency of Great Britain on her west. While on the surface more easily assimilable than the Teuton because he speaks the language of his adopted country, he is first an Irishman,* then an American, and such only so far as it is an America of the green flag. A distinction must, however, as already observed, be drawn between the natives of the north and those of the south of Ireland—the Saxon Ulsterites and the Celts. From the latter is derived the large proportion of our delinquent classes; the Molly Maguires were Irishmen, and it is the Irish who have had the largest share in the corruption of our governmental institutions. The Ulsterites, on the contrary, being principally of Scotch and English stock, partake of the characteristics which mark the British alien in America.

It is unfortunate that a few unassimilable Englishmen, who never had any intention of becoming assimilated, and who are at all times aggressively British, should have conveyed the impression that the British immigrant does not make a good citizen. On the contrary, there are to-day over a million people in all parts of this country born in Britain, honest, frugal, hard-working, and industrious, fulfilling by reason of their close affiliations with the people of the United States all the requirements of the best American citizen.

There are, as we know, other races, Latin and Slavonic, wretched and ignorant, the superlatively low, the refuse of civilization, unaccustomed to freedom, unacquainted with equality; they have the privilege after a brief period of residence of exercising all the rights of native-born citizens, but only value the franchise at the pecuniary worth, or vote blindly under the direction of some corrupt demagogue. Coming from a condition bordering upon serfdom, it will be found that they are almost unassimilable, in the first generations at least; incapable of distinguishing liberty from anarchy, these people—principally Russians, Poles, Hungarians, and Italians—are landed on these shores in numbers probably in excess of fifty thousand a year.

The anarchist and ultra-socialist parties do not, as is commonly supposed, derive their chief support from the Teutonic element; their ranks are rather recruited from among these members of the Semitic

* The great pilgrimage which will be made to Ireland during the coming summer by thousands of American citizens of Celtic extraction to celebrate the centenary of 1798 furnishes us with one demonstration of this proposition.

and Slavonic races. At the late presidential election the socialist vote in New York city was 7,326, an increase of about fourteen hundred over that polled in 1892. Doubtless, as the socialists claim, the increase would have been much more considerable had not the silver question for the time taken precedence of all other issues, although the socialist propaganda publicly declared against free silver. In 1895 the party polled 10,993 votes. The significant feature of the situation, however, is the marked increase in the party's vote in the ninth congressional district, situated on the east side of the city, south of Stanton Street. Here more than half the socialist vote was polled. It is here that the socialists expect to elect, within a few years, an assemblyman to represent them at Albany; it is from this district that they hope ultimately to send a congressman to Washington. In the twelfth assembly district, constituting a part of this congressional district, the result of the recent election was tabulated as follows: Tammany (Democrat), 2,590; Republican, 2,257; Socialist, 1,284. It is in this section of the city that the socialists are centralizing, that the most active party leaders are colonizing. Such imperfect statistics as are available reveal the fact that the Hungarian, Polish, and Russian population stands in the ratio of 5 : 1 to that of all other nationalities. Many of the first three named peoples are not yet voters, but each year the naturalization mill turns them out by thousands as free electors, after they have solemnly sworn to uphold the Constitution of the United States. Yet the socialist ideals are entirely at variance with the true theory of American government as conceived by the early makers of the American state. The question, then, confronting us is whether the process of assimilation or the growth of socialism will be the most rapid.

I had thought to find every advance made in civilization distinctively associated with a certain race or races, and while the characteristics of many races have become implanted in and integral parts of the national civilization, yet I am obliged to admit after deep reflection that such advances are due in greatest part not to the individual or the race, but to the entire foreign element. When the number of immigrants was comparatively small they became quickly amalgamated with the native population, but as the numbers increased, progress in this direction was naturally slower, yet in no other country has the process been carried on so quickly and thoroughly in proportion to the amount of material to be acted upon as in the United States. As the national spirit acts upon the foreign element, so the foreign element reacts upon American civilization: there results one heterogeneous whole, and this increased heterogeneity arising from an admixture of nationalities is, as already intimated, the primal cause of American progress. It is a little re-

markable, however, that the application of this principle should have almost escaped the attention of every writer upon this subject, or been lightly passed over by them. Mr. Giddings, whose work on sociology is the only one based upon American inductions, scarcely notices it; and his associate, Mr. Mayo-Smith, while he has examined the subject of immigration extensively, appears to have entirely overlooked the real value of the foreign element.

It is in the purely American commonwealths that civilization is to-day the lowest; the coast States, from Virginia to Louisiana, have a foreign population of only 1.61 per cent,* yet it is here that the illiteracy is greatest, and that there is least commercial and industrial progress. It is this section, too, which produces the clay-eater and "cracker," native-born white American citizens, yet so degraded that continental Europe can scarcely show a lower type of man. It was the solid American vote of the South which at the late election was cast for Bryanism, repudiation, social upheaval, and all else that that name implies. North Carolina, which does not contain within its borders a single town having a population in excess of twenty-five thousand persons, has the highest degree of illiteracy among its white inhabitants, and the smallest proportion of foreign population of any State in the Union. Lest it should be imagined, however, that it is the alien which has the effect of reducing the aggregate illiteracy in the Northern and Western States, it may be remarked that the percentage of illiteracy is almost invariably higher among the foreign than among the native element.

It has already been pointed out that it was the civil war and slavery which in part caused a regression in Southern civilization of at least a quarter of a century, but it will be found that this misfortune was closely associated with the homogeneousness of the people and the absence of a foreign element. In 1884 the Southern Immigration Society met at Nashville. In the report of its proceedings appeared this significant statement: "*The immigration movement is to be the great revolutionary movement in the political economy of the South.*" The society has probably ceased to exist, but these words have lived and borne fruit. There is to-day a movement toward the South, partially from abroad, more from the North, but introducing at least a new element—not very great, perhaps, yet still perceptible, not only in a changing population, but also in results, in a revival of industry, in a decrease of illiteracy.

Louisiana stands alone; already a well-established colony possessed of a high degree of civilization borrowed from France when acquired by the United States, there exist so many different factors

* United States census, 1890.

in her development scarcely relevant to this article that I may not examine them here. The agricultural depression and other causes which have given rise to militant populism in the West have received their full share of attention from numerous writers, and it will therefore suffice to say that they do not appear to be in any way associated with the foreign element.

I have only been able in this article to give a rough outline of the effects which the alien has wrought on the civilization of the United States; much of consequence has been left unsaid, many important stages of development omitted. I can at most claim to have drawn attention to some important facts hitherto overlooked, and to have pointed out a direction which future investigation may follow in an endeavor to solve the great immigration problem.

THE CAINGUÁ OF PARAGUAY.

By Dr. MACHON.

THE several tribes of Cainguá Indians are scattered through the immense forest region that extends from the Ygatini to the Monday, and from the central Cordillera of Paraguay to the banks of the upper Páraná. In the midst of those grand *yerbales* (forests containing the *maté*, or Paraguay tea plant), these children of the forest dispute for their hunting grounds with the "Tupi," or refugee braves from Brazilian hostility. Like the latter, they belong to the Guarani-Brazilian race, and speak the Guarani language. They form numerous groups of population, divided off into small tribes that live isolated from one another, and assemble only occasionally to resist an invader or undertake some expedition. Like the ancient Guaranis, their native docility is so great that we can easily comprehend how the Jesuit missionaries gained an ascendency over them. There is no doubt in my mind that the Cainguá, whom I had an opportunity of studying, were subjected to that influence about two hundred years ago, and have since gradually fallen back, after the decline and ruin of the missions, into their primitive savagery. Of this bare contact with civilization they still retain their belief in a Supreme Being living in the sky, and know something of St. Thomas. But, aside from these rudimentary notions, their religion is null and destitute of every kind of outer worship. A few of the old men recollect some of the Latin hymns with which their ancestors rocked them to sleep, and they have preserved a hierarchical organization from the past.

Every *tapui* or village has its cacique, who is dependent in time

of war on a supreme chief, and in time of war, too, has under his orders a series of officers bearing the titles of *teniente* (or lieutenant), *sarjente* (sergeant), and *cabogrades* (corporal). But in time of peace these grades imply no authority. The whites inspire a respectful fear in them, and while in their relations with us—which they rather avoid having—they behave honestly, the honesty is the result of dread of the white man's presence.

Recognizing the value of the protection of the white man, they would more frequently have recourse to him for defense against the Tupi, but that they would have to pay for that protection by the servitude into which they would fall. Now they avoid the white man too, and it is only the desire of exchanging labor for objects of prime necessity that prompts them to give their services in the collection of *yerba* or *maté*, and the getting out of building timber.

Their *tapuis* or villages are situated in the depth of the forest in a clearing, or on its edge near a stream. When they are a short distance from a navigable river, the people make a path that leads to the place on the shore where the canoe used in fishing is moored. These villages generally contain only a very limited number of families, each of which has its own house. At a shorter or longer distance away, in an artificial clearing, are small plantations of manioc, yams, and maize, which are reached by paths cut through the thicket.

The house of the Cainguá is smaller, but better built, than the Paraguayan ranch. The frame of roughly hewn trunks of trees supports a thatched roof and bamboo walls covered with a layer of mud mixed with plant stalks. These houses have no windows; the low and narrow roof is usually furnished with a large palm leaf as a *portière*. The floor of the cabin is made of beaten earth, and the furnishings are simple and rude. A single piece of furniture that is never wanting is the *tatou*, a kind of seat made out of a rudely shaped piece of wood which in form resembles the animal (the armadillo) after which it is named.

The Cainguá have no beds, but usually sleep on the ground. The few hammocks they have, formed of a bundle of leathern strips bound together by transverse knots, are considered objects of luxury reserved for the men. Antonio, a young Indian whose guest we were for about five days, found it quite natural to rest in the hammock from fancied fatigues, while his poor little wife, hardly a dozen years old, lay upon the bare ground at a nearly freezing temperature, although she was in a delicate condition. Some bamboo bundles, set a short distance above the ground, were not beds, like those we saw among the Toba Indians in the Chaco, but supports on which provisions were piled in anticipation of the heavy rains. Large

calabashes for carrying water were hung on the walls of the cabin, as were also the spare arrows, the crop of wild cotton, and all the thousand nothings which these big children have the craze for collecting.

The fire is built out of doors when the weather permits it; but when it is raining, or is cold, it occupies the place of honor in the cabin, and men and animals sit around the blaze without seeming to be troubled by the smoky atmosphere. Fire is obtained by means of two sticks of dry wood, one of which, held tight between the feet, receives the end of the other. The second stick is revolved between the hands with a rapidity on the degree of which the production of the desired spark depends. The water is boiled on the fire for the *maté*, which is taken without sugar by means of a reed pipe; and the game is roasted there. If the weather is rainy, and laziness does not overcome the disposition to work, as it generally does, the man, smoking his pipe, weaves baskets and sieves for household use, and his wife oversees the preparations for the meal, or spins cotton, from which she makes a very durable cloth.

The men are generally well built and of medium stature; their limbs, especially in youth, are well developed—a result of their constant handling of large bows and their fondness for long walks. The color of their skin is a fine bronze, with variations that are largely dependent on the relative cleanliness of different individuals. With the bachelors, the ebony hair is worn flat, and covers the nape, while the married men wear it short and curled. Generally they wear no ornaments on the hair; but if there is occasion for it, the Cainguá bind their locks with a colored kerchief and perhaps put in a few feathers. Some travelers have spoken of tribes marked by their lighter tint and blond hair; so far as we have been able to find, there exist a few families in which albinism is hereditary, and this is probably what gave origin to the legend. Their face is full and round, the nose somewhat flattened, and the nostrils open, made so by the people's enlarging them with their fingers. The middle part of the lower lip is turned outward and pierced. The eyes, oblique, and always looking outward, give the physiognomy a very mild, even feminine, character.

The masculine dress consists of drawers terminating in fringes and bound in front and behind by a belt of braided hair; and for ornament a double collar is worn of the hard seeds of certain vegetable species mingled with variously colored bits of glass and vertebræ of small reptiles colored brown with *quebracho*. Under this collar a little pocket of raw hide holds the chewing tobacco. All, young and old, men and women, wear the *barbote*, or a hole in the lower lip, by means of which they can perfectly imi-

tate the various cries of birds. The flesh is bored for this at about four years of age with a sharpened bamboo stick; then, to prevent cicatrization, the orifice is kept open by drawing through it occasionally a leaf of dry grass. The higher caciques, we are told, alone have the right to wear in it, as a mark of their dignity, a plug of hardened yellow and transparent resin in the shape of a T.

The women are small in stature; their forms are slighter than those of the men. Their hands are very fine, and their hair is seldom combed. Their dress consists of a sort of small skirt folded around the form and descending to above the knees. Like the men, they go out barefooted, with the chest covered with several strings of beads, to which they sometimes attach a few bones for amulets. They also wear bracelets of hair, and eardrops composed of a string of red and white pearls, ending in a small triangle of nacre from one of the shells of the country. When young, they are quite attractive, although disfigured by the painting with which they mark their faces, consisting of a series of horizontal and vertical lines traced with charcoal dust, or a layer of beeswax which they put upon their skin. To be fresh, it has to be renewed every day. The young men also employ it to make themselves pleasing to their sweethearts, but married men put on no colors.

The children wear a miniature breeches or small petticoat; only the babies are naked. The feeling of modesty is so well developed among these Indians that it was a hard task to get one of these children's costumes, and still harder for the young fellow to exchange his breeches for the handkerchief we gave him.

The life of the Cainguá is divided between hunting and fishing. His arms, which he is never without, consist of a bow and a bundle of four arrows. The bow is about six feet long, and the arrows are nearly five feet. They are of guaiacum wood and the strings are of *caraguáto* (a vegetable fiber). In exchange for working in the *yerbales*, the Cainguá obtains from the whites machetes, knives, cooking utensils, and farming implements.

His fishing canoe is hollowed very patiently in a cedar log. The hooks come from abroad, and the line is made of fibers of the *caraguáto*, or some other textile plant. They shoot their arrows aiming them directly at the object or firing them first into the air; for this purpose they throw the bust back, an exercise which develops the muscular system in a remarkable way. They never lay themselves on the back to shoot, as most of the Brazilian Indians do. Their skill is very great, but their game bags are often very scantily filled. The game is generally composed of various species of birds, which they stun by means of an arrow ending in a wooden knob. Two other arrows, ending in points barbed in various ways, and of

hard wood, are styled war-arrows, while a fourth kind, the only one having a metal point, is reserved for the tapir.

In hunting this animal—an important feature in the life of the young Cainguá—they display all their knowledge and all their skill. Perched on high trees or hidden in the underwood, they wait for the animal to pass, and wound it mortally with their steel-pointed arrows. A merciless pursuit then begins, and does not end till the timid, harassed pachyderm dies of exhaustion. The chase of the jaguar is more perilous, and sometimes ends in a fight at close quarters.

The Cainguá also set traps, and sometimes travel for hours in the underbrush to visit them, with their arms in their hands and their provisions in their *bocco*, or basket made of *caraguáto* fibers, which they carry slung over their shoulders. When game is scarce, or indolence keeps them in their lodges, they hunt the rats and field mice that swarm in their winter's provisions; the victims, slain with sticks, are immediately put upon the fire just as they are, and devoured on the spot.

Work in the house and the fields devolves upon the women. They carry their burdens on their backs in a pretty basket. They make blackish earthen vessels out of a clay which they go a considerable distance to get. Another finer earth is the material of a pipe in which the husband smokes the leaves of a wild tobacco. Contrary to the Paraguayans, the women do not smoke. In one family we saw a horn spoon like that of the Lengua Indians of the Chaco. Aside from the dogs and the hens which only the rich possess, the Cainguá have no domestic animals. The parrots which are seen quite numerously in the villages, tied by one foot to a light clog, are there only as a reserve for the kitchen.

The only formality which the swain has to go through to get the hand of his promised one is to kill a tapir, an act by which he proves that he will be capable of supporting his prospective family. The death of a tapir under such conditions is quite an event; the whole tribe assembles at the carcass, and a scene of gluttony begins that does not cease till nothing is left but the skin and bones of the "great beast." That is the only ceremony of marriage. The Cainguá is usually monogamous, but polygamy is allowed. Marriages of relatives are carefully avoided. After confinement, the young mother has a rest of a few days before resuming her servile task. She carries the newborn infant in a scarf, or sort of little hammock slung over her shoulders. She does not think of weaning it for a year and a half or two years, while the child has already been exercised in arms with miniature bows. Ideas of cleanliness seem foreign to the women as well as to the men, and it is a lucky chance that will induce them to comb their magnificent heads of hair.

Like the big children they are, they burst into laughter at nothings, and laugh immoderately at whatever is new to them. Never shall I forget the hilarity and curiosity which possessed our friends of Puerto Venezia as they watched me one day changing my clothing. The braves, squatting on their toes or leaning against the wall, pointed at each article of dress, and were greatly amused at the specimens of the refinement of our civilization of which they evidently could not understand the bearing.

Their musical feeling is still in infancy, and their musical instruments are extremely primitive. They play the simplest kinds of airs on a bamboo flute or a guitar rudely imitated from the Paraguayans, and dance or rather jump to them with their feet held together or pushed one before the other, holding the lobes of their ears between the thumb and forefinger. Sometimes the dancers wear also a belt composed of a series of hoofs of animals, which, clattering against one another, make a noise like that of a little bell. They hold a rattle in their hands, shaking it rapidly, which consists of a kind of fiddle-case rudely cut with a knife, containing bits of glass.

Their feeling of jealousy goes to the extreme, and dominates all other feelings. It is the direct or indirect cause of all the crimes and all the personal and tribal quarrels. The stranger, whom they nevertheless fear, may even sometimes run the danger of his life if he betrays too tender sentiments toward one of the damsels of the woods. In the first village we visited, the mere fact of our stopping a moment to look at the girls in order to study the arrangement of the designs with which they were decorated aroused the susceptibilities of their lawful lovers, and prevented our getting several things we wanted. Further, a young man who had probably not yet succeeded in killing his tapir, turned the bare blade of his machete nervously in his hand at seeing my companion trying the weight of his intended's eardrops before offering to buy them.

Notwithstanding their entire want of religion, the Cainguá have a vague idea of a future life; for after the interment of a deceased relative they deposit on the new grave the arms of the departed and provisions for the journey which they evidently suppose to be possible. Their innate indolence, which only the Jesuit fathers were able to contend with successfully, and their indifference are likely to keep them for a long time backward in civilization.—*Translated for the Popular Science Monthly from the Bulletin de la Société Neuchâteloise de Géographie.*

SKETCH OF FRANCIS LIEBER.

By Dr. LEWIS R. HARLEY.

FRANCIS LIEBER fled to our shores a political exile, but he afterward became one of the greatest publicists of the world, and shed glory on American scholarship by expounding the principles of liberty. He accomplished in two of our colleges the work on which his fame will rest. Although he attained his scientific maturity in America, he was born in Berlin, and received his scientific training in the schools of his native land and in his intercourse with some of her most noted scholars. Lieber was born March 10, 1800, and his youth was passed during a time of intense political strife. He was the tenth child of Frederick William Lieber, an ironmonger, whose family consisted of nine sons and three daughters. From his earliest years his mind was impressed with the memories of warfare, and his father delighted to explain to him the engravings on the walls of the sitting room representing some honorable actions of his great king. His mother was one of those noble, patriotic German women who threw their gold wedding rings into the public treasury, and received rings of iron in their places, bearing the imperial signet and the words "We gave gold for iron." Lieber was but six years of age when the Prussian army was annihilated at Jena, and the country lay prostrate at the feet of Napoleon.

Lieber's first desire was to become a botanist. To this end he entered the Botanic Garden near Berlin, but he remained there only a short time on account of the ill treatment that he received from the director of the garden. The guiding principle of his school life came from Dr. Jahn, who settled in Berlin in 1809 to establish a place for physical exercise. Lieber became one of his pupils as early as 1811. Dr. Jahn realized the fact that Germany needed to be brought into a proper state of enthusiasm before it would be able to resist the French, and while he trained the young men for the battlefield he took every opportunity to appeal to their national spirit. He urged the necessity of German unity, and his hatred of France was so intense that he expurgated from the language of his school all words of French origin. Hence, he chose the word "*turnen*" as the German name for his gymnastic exercises. This system of education was the flowering of the seed that had been dropped by the French philosopher in "Émile," a book which brought forward a new problem in the education of the young in the eighteenth century. "Émile" was everywhere read, and aroused the greatest enthusiasm. The teachers sought to aid the movement in various ways, but Dr. Jahn made the best statement of the advantages of physical training, and

he gave this training a permanent place in the German system of education. His personal influence was great, and the desire of his life seemed to be to establish German unity.

Lieber remained under the instruction of Dr. Jahn until the age of fifteen years, when his school career was interrupted by the trumpet tones of war, calling the youth to the defense of their country. When Napoleon escaped fron Elba schoolboys were welcomed in the Prussian army, and Lieber served as a volunteer in the Waterloo campaign. He received two wounds at Waterloo, and after recovering in the hospital at Aix-la-Chapelle he returned to his home in Berlin. He at once resumed his studies under the guidance of Dr. Jahn. In 1819 the schools for physical exercise in Prussia were closed. The same year Dr. Jahn and Lieber were arrested as enemies of the state. Upon his discharge without a trial, Lieber was refused permission to study in the Prussian universities, but was finally admitted to Jena, where in 1820 he took his degree. Being under the constant guard of the police, he decided to leave his native country, and, as the Greek Revolution had just broken out, he made his way to Greece and took part in the struggle. He became disgusted at the miserable condition of things there, and, returning from Greece, he spent some time in Rome with Niebuhr, the Prussian minister. He then proceeded to his native land, but was again placed under arrest for entertaining liberal sentiments. On his release he decided to make his home in America, and in 1827 he arrived in this country.

Lieber was recommended by Dr. Jahn as a suitable person to introduce the Prussian system of physical culture into the Tremont Gymnasium in Boston. Here he taught scientifically Prussian gymnastics; and he was one of the first exponents in America of the physical basis of education. The liberality of his views on education is well illustrated in his plan for the organization of Girard College, which attracted widespread attention. It reveals the fact that he had a wonderful grasp of pedagogic questions, and but few recent writers have made any advance beyond his liberal ideas. At that time there were no polytechnic schools in America, and Lieber's plan included the various branches of polytechnic instruction, as well as provision for the education of teachers. In commenting on the plan, Edward Livingston wrote from Paris in 1834: "You have written three lines which ought forever to be impressed on the minds of all teachers, whether of science, politics, or religion. I know of no truth more happily expressed than that 'there is a religion under all the variety of sects; there is a patriotism under all the variety of parties; there is a love of knowledge and a true science under all the variety of theories.'" As early as 1858 Lieber strongly urged the establishment of a real university in this country, as a cultural means

of promoting a more generous nationality. This was twenty-five years before the university ideal was reached in America. His conception of a university included all that our most venerable institutions have yet realized.

Lieber struggled for eight years before he found any permanent employment. In 1828 he began the work of editing the Encyclopædia Americana, and in his project he was warmly supported by Edward Everett, George Bancroft, and Judge Story. He yearned for the time when he might be able to write upon subjects that had long occupied his mind. In 1835 his hopes were realized by his appointment to the professorship of history and political economy in South Carolina College. In his contact with Niebuhr at Rome he had acquired a taste for historical studies, and he became the first great teacher in this country of history and politics as co-ordinated subjects.

It was Lieber's lot to encounter many obstacles in his career. Although as a boy his soul longed for liberty, he found even in America a part of the human race in bondage, and this earnest advocate of freedom was compelled to make his home in the very midst of the slave power. Lieber did not desire to go to the South, but after a struggle of eight years in the North he felt compelled to accept the position in order to provide for his family. It also afforded him leisure time to write his Political Ethics, Legal and Political Hermeneutics, and Civil Liberty and Self-Government, the three great works upon which his fame will chiefly rest. In 1856 he was a candidate for the presidency of the college, and, failing to secure this position, he resigned his professorship. The next year, he was called to Columbia College, New York city. Dr. Herbert B. Adams states that the call of Lieber to Columbia College marks the first recognition by a Northern college of history and politics as properly co-ordinated subjects. Lieber spent nearly forty years as a teacher of this most vital branch to the youth of the republic.

Before tracing out the leading theories of Lieber's works, it may be well to refer to the political thought of his day. His youth was spent in a period when in his own country two opposing schools of law and political science existed. The historical school based its method upon the course of outward events and their evolution, while the philosophical school began with the knowledge of the human mind, and from this starting point considered the revelation of the spirit of man in history. Dr. Bluntschli says that only a few philosophers have had the genius to unite the two methods. Lieber rose above the conflict of the two schools and became one of the first representatives of their alliance. In writing his great works he had to venture upon an untrodden path, and, in his Political

Ethics, also a dangerous one, because in exploring a new field he had to touch some of the most vital and delicate points. His life in the South, although uncongenial to him, was a period of rich production, and he became the author of the first great original treatise on political science in America. He had long occupied himself with the thought of writing on political ethics. He felt that the many subjects which have a strong influence on politics, and yet do not belong to political or legal science, should be treated soundly and truthfully. These subjects included the ethical nature of man, public opinion, parties, factions, opposition, love of truth, perseverance, the duty of representatives, judges, advocates, officeholders, and the pardoning power. The keynote of the Political Ethics is, "No right without its duties, no duty without its rights." The work called forth the warmest admiration of jurists, statesmen, and historians.

Lieber made another valuable contribution to political science in The Legal and Political Hermeneutics, published in 1839. One of the first articles which he read after landing in New York was in a paper opposed to the administration of President Adams. The writer founded his objections on the construction of the Constitution. The subject was new to Lieber, as political construction of this kind is peculiar to America, where the idea of a written constitution was first realized on a large scale. His attention was attracted by the novelty, and when he began his work on Political Ethics he was led to reflect more deeply on constitutional construction. The value of the work is stated in The Nation as follows: "Many of the topics discussed were at this time new, doubtful, and difficult, and Lieber lived to find conclusions which he had arrived at and was the first to express thirty years ago, referred to by writers of the present day as familiar political truths, without, perhaps, any conception on the part of the writers of the source whence they were derived." Lieber's best known work and greatest contribution to political science is his Civil Liberty and Self-Government, published in 1853. It was written during the vicissitudes of the French Government, and can not be read with profit without taking into view the events of 1848 and the empire of Napoleon III, for through the book there are drawn frequent contrasts between Anglican and Gallican liberty. The Civil Liberty and Self-Government at once attracted the attention of scholars. In 1854 Woolsey put the book into the hands of his pupils in Yale College. Professor Creasy, of England, author of the Rise and Progress of the British Constitution, said: "Dr. Lieber is the first who has pointed out the all-important principle of English and American liberty, that every officer remains individually responsible for what he does, no matter whether he acts under the order of his superiors or not—a principle wholly unknown in

other countries." The work was translated into German by Mittermaier, and found a warm welcome in Europe. Lieber was interested all through his life in the subject of penal law. When De Beaumont and De Tocqueville published their report on American prisons, they requested him to translate it into English, and he did so in 1833, adding copious notes, for which he received the thanks of some of our leading jurists. The King of Prussia desired to appoint him inspector general of prisons, with the permission to lecture on penology in the university.

In his later years Lieber's attention was especially directed to the subject of international law. The following words of the late Dr. Bluntschli tell of his great activity in this direction: "Lieber had great influence, I may add, in founding the *Institut de Droit International*, which was started in Ghent in 1873, and forms a permanent alliance of leading international jurists from all civilized nations, for the purpose of working harmoniously together, and thus serving as an organ for the legal consciousness of the civilized world. Lieber was the first to propose and to encourage the idea of professional jurists of all nations thus coming together for consultation, and seeking to establish a common understanding. From this impulse proceeded Rolin-Jacquemyn's circular letter, drawn up in Ghent, calling together a number of men, eminent for their learning. This latter proposal to found a permanent academy of international law met with general acceptance, but this was merely a further development of the original idea of Lieber, which was at the bottom of the whole scheme. His notion was now approved and the efficiency of the association was thus assured for the future."

Lieber's contributions to military law form the greatest work of his later years. At the instance of President Lincoln he prepared Instructions for the Government of Armies of the United States in the Field, which being approved by a board of officers and by the President, were published in 1863, as General Orders, No. 100. This work, the first codification of International Articles of War, forms a permanent addition to military law. The adoption of the code brought Lieber into close relations with the War Department at Washington, and he became its adviser in all matters relating to it. The codification was received with great favor abroad. It suggested to Dr. Bluntschli the idea of codifying the laws of war and the law of nations. His letter to Lieber is printed as a preface to the International Code; and he valued the instructions for the armies so highly that he had them published in full as an appendix to it. In 1863, at the request of General Halleck, Lieber prepared an essay on Guerrilla Parties which was received so favorably by the Government that an attempt was made to have a chair on the law and

usages of war established at West Point, and to secure the appointment for Lieber. This was never accomplished, but at the close of the war he was appointed to classify the Confederate archives in the office of the War Department.

Although Lieber was so firm a Union man, we may behold in him the symbol of civil war. His eldest son, Oscar, laid down his life for the cause of secession. His other two sons held commissions in the Union army: Norman, who became a lieutenant, and is now Judge Advocate General, and Hamilton, who lost an arm at Fort Donelson. Although Lieber took a deep interest in all public measures and followed closely the current of political thought, his mind was not adapted to take a practical, everyday part in current politics. His heart was bound up in the welfare of his country, and he could not descend to the level of the partisan. In a letter to me, Hon. A. D. White thus speaks of Lieber: "As regards taking a practical, everyday part in politics, I never thought him of the build for that. In fact, I once saw a curious exhibition of his inability to take such part. He had been elected a delegate to a State Republican Convention, and came up to Syracuse, where I then was, to attend it. As he was my guest, I suggested to him, when the time arrived for calling the convention to order, that we should go to the hall where it was held, but he was engaged in very earnest political talk with me, and put off going, probably with the idea that not much would be done until his arrival. We reached the hall about an hour late, found it in all the noise and uproar which generally attends the sessions of such bodies, and, as we listened to a roll call, found that another delegate had claimed his seat and had been admitted. He heard the name of his opponent called and responded to, said not a word, listened a little longer, then proposed that we should take a walk, and he never went near the convention again."

Lieber died October 2, 1872. One who best knew him declared that by his death the whole world sustained an irreparable loss. The influence of his profound works upon the public mind has been great. It has been charged against him that he was a *doctrinaire*, but even if this were so, it would be no reproach. While strongly grounded in the best thoughts of the best thinkers on political subjects, he was as independent in his thinking as any wise man is likely to be. However restricted may have been his popular influence as an author, his opinions and writings have been valued by the foremost thinkers of the age in every land of well-ordered liberty, and his works have been a mine of wealth to thousands who never acknowledged it. "No right without its duties, no duty without its rights," was Lieber's favorite motto, and his life and writings were molded by this principle.

Correspondence.

A CURIOUS OPTICAL PHENOMENON.

Editor Popular Science Monthly:

SIR: To one interested in observing the action of light under unusual circumstances, a very pretty display of colors can be seen in the amalgam room of the Ojo de Agua Silver Mill at San Luis de la Paz, Guanajuato, Mexico.

This room is twelve feet wide by twenty long, with whitewashed walls. The outside wall faces the northeast and is pierced by two large windows, covered with heavy wire gratings and coarse white muslin. Opposite these windows and against the southeast wall are large iron kettles set two feet above the floor in solid cement. Above these in wooden racks are hung heavy canvas sacks two feet long, to receive and strain the liquid amalgam as it comes from the settlers. This amalgam runs into the sacks, and the excess of quicksilver percolates through the coarse canvas and falls in a shower into the kettles below.

To one standing in front of this shower will appear some of the colors of the spectrum. A transverse section of this cylinder, representing the body of falling metallic particles, would have a diameter of from five and a half to nine inches, according to the rapidity of the discharge of amalgam into the top of the sack. The slower the discharge, the smaller the sectional area and the larger the individual drops, and *vice versa*.

The colors are repeated six times in the width of the stream, three times on each side of the center line or axis. This is observed at a point halfway between the surface of the "quick" in the kettles and the flow of particles from the sides of the sacks, the colors forming a line coincident with the horizontal plane. Of course, this changes slightly with the position of the observer, in accordance with the law of incidence and reflection.

The refractive action is toward the outside, as the violet appears at the outer edge. This (the violet) is fairly strong, the indigo fainter, and the blue *nil*. Under the most favorable circumstances only can the green be detected. The yellow is about as strong as indigo, the orange of the same value as the violet, and the red most pronounced of all.

The red of each outer spectrum borders on the violet of the next inner on each side of the center, and this is repeated in the second pair where they connect with the inner or last pair. The third or inner is so faint that only the violet is visible, and that but faintly. There seems to be a gradual decrease of intensity toward the center, which is not apparent from the fact of the stronger end of each spectrum being inside; that is, the stronger end (red) of the first or strongest spectrum coming against the weaker end (violet) of the second or weaker spectrum, etc.

The greater the volume the smaller the individual particles and the stronger the colors, and *vice versa*. Late in the afternoon the sun shines on the windows, but does not occasion an increase in the value of the colors, except when some opaque object is interposed. In fact, it is always best to stand facing the "quick" and between it and the window opposite. Direct sunlight never enters the room, the windows being covered with coarse white muslin as above stated. Artificial light produces the same effect as sunlight.

The condition of the "quick" is as follows: While in the receiving kettles it is kept under a saturated solution of caustic soda to cut any grease which it may collect in passing through the pans and settlers. It contains a trace of zinc and possibly of silver. If lead, copper, or iron in the form of amalgams are present, they are in such very small proportion that it is impossible to estimate them.

It may be that in falling there is formed a film of varying thickness of zinc oxide on the surface of each globule which would have a decomposing action on the light reflecting from the surface of the globule on which it would form a coating. This I merely advance as a hypothesis.

HENRY M. STANLEY.

MEXICO, D. F., *November 1, 1897.*

Editor's Table.

EDUCATION IN BONDS.

THE warfare of science with theology has been amply and impressively related by such writers as Buckle, Draper, and President Andrew White; and many have supposed that science, having accomplished this warfare and come out

victorious, had no other foe to fear. There are not wanting signs, however, that complete confidence on this point may be somewhat premature. Another enemy has appeared in the field, less severe in aspect than the old theology, but also less disinterested, less sincere, and, strange though it may seem to say so, less open to argument. That enemy is party politics, and the science it especially attacks is the highest science of all—the science of society in its various branches.

The very essence of scientific teaching lies in its freedom. Teaching that is not free can only usurp the name of science. If the word means anything, it means the movement of the human mind toward truth, toward a true comprehension of things. The world and life furnish facts; it is for science to observe, examine, tabulate, co ordinate those facts, and extract from them their widest and deepest meaning. Science does this in the interest of mankind, in order that we may all understand the conditions surrounding us in the world, and apply our energies in the most profitable manner for the promotion of our own and others' happiness.

Bearing this in mind, we may see an ominous sign of the times in an article which appears in the October number of the American Journal of Sociology describing how the Populist party in the State of Kansas, having captured the State Legislature, proceeded to make a raid on the State Agricultural College, where, after some preliminary maneuvers, they dismissed a considerable portion of the faculty, including the president, in order to insure that the doctrines taught therein should be in a line with Populist politics. The previous government of the college had been all that could be desired; there was no pretense that it had allied itself with any political party as such, or that the teaching given within the college walls had been other than the best thought of competent men dealing disinterestedly and honorably with their several subjects. The idea simply was that here was an opportunity for converting the college into an instrument for promoting Populist views and the success of the Populist party, and that the opportunity was too good to be lost. The first step taken was to pass a resolution to the effect that "the principles maintained by the advocates of land nationalization, public control of public utilities, and the reform of the financial and monetary system shall be fairly stated and candidly examined, with a view of leading the student to grasp the principles involved in the science of production and distribution, without bias or prejudice." To secure more complete freedom from bias or prejudice in the teaching of economics the board next proceeded to take that subject out of the hands of the president, Prof. G. T. Fairchild, who had been in the habit of lecturing on it, and sent for a man after their own heart, whom they found in a certain Professor Will. The lectures of the latter are described as presenting socialistic views as though they were beyond criticism, and as affording much satisfaction to the Board of Regents.

The next step was to declare that the employment of all the professors and instructors should expire on June 30, 1897. This gave the opportunity for getting rid of those whose views were considered in any way objectionable, foremost among whom was the president, who did not, however, wait for the expiration of the period before sending in his resignation. Out of twenty-four teachers twelve were reappointed. Henceforth, therefore, or until the political complexion of the Board of Regents changes, the

agriculture taught at the State College will be duly mingled with populism, and whatever benefit that can confer on the community at large will be duly reaped. That some benefit is expected may be inferred from a report made by the board after they had secured a new professor of political economy, in which they expressed themselves as follows: "It is not a lack of industry or unfavorable methods of farming, or the unfavorableness of the climate which have caused the widespread and ever-increasing poverty among the agricultural and laboring classes. The unremitting toil of the farmer, in which sons and daughters take part, even during childhood, has indeed yielded him large quantities of grain, great numbers of cattle, hogs, horses, and other domestic animals. He has produced enough of the useful and necessary things of life that, with fair, equitable exchange, would bring prosperity in place of poverty, comfort in place of humiliating drudgery, and content and patriotism in place of unrest and dissatisfaction." The trouble, then, is not that the farmer has not plenty of grain and animals, but that he can not exchange them on the terms he would wish for other things. Who are the people that are holding on to the other things, demanding such prices for them that trade is either impossible or very one-sided? Is it the cotton manufacturer, or the boot and shoe manufacturer, or the cabinetmaker, or the manufacturer of plows and other farm implements? We do not think any of these would acknowledge the impeachment, for if there is anything they are anxious to do it is to sell, and the prices they ask were never so low as they are to-day. We should like very much to know what remedy Professor Will would suggest in the premises. Is it not the fact that what to-day is considered poverty would a couple of generations ago have been considered comfort? Upon another page of the Journal of Sociology, in an article by the editor, Prof. Albion W. Small, we read that "the toiling millions can buy with their wages more comforts than they ever could before," but that "the individual laboring man is haunted by the thought that he may any day lose his job." Well, that is where the farmer has an advantage; he is not in danger of losing his job, and, according to Professor Small, he can get more for his money than he ever could before. He may get less for his grain than formerly; but, on the other hand, he has much less labor both in producing it and in bringing it to market.

We do not propose, however, to discuss questions of political economy in these columns. The question which seems to us full of grave interest is, how far the party control of college teaching is destined to proceed. The trouble, of course, is not entirely new. In protectionist states there is but little "liberty of prophesying" for free-trade professors; but the case is more serious where parties, in the interest of their own supremacy, begin to impose the teaching of doctrines that touch the deepest foundations of society. All political control, however, in such matters is bad. The only way to have great teachers is to seek out men who have profoundly studied their several subjects, and whose disinterestedness in expounding them is beyond question. Such men may commit errors, but they will give inspiration and will so educate the judgment of their pupils as to make them incline to sound and reasonable views. He who is teaching by prescription will never teach with conviction. Truth does not need to be prescribed; it prescribes itself if it gets the chance. The greatest enemy of truth is organ-

ized self-interest, and it is precisely this enemy with which our system of higher education—in so far as it depends on State support—is beginning to be threatened. If the evil spreads, the result will be the disorganization of all State universities and colleges, because the youth of the country will not long consent to listen to lectures that express, not the thinking of an independent mind enriched by the thoughts of other independent minds, but a system of doctrine carefully adapted to help this or that party in its political struggles. Theology was a tyrant in its day, but it was a respectable, high-minded, and benevolent tyrant compared with the political party that would attempt to capture and pervert education for its own ends. Theology did not object to cramp men's minds if it could only save their souls; but the politician would do it in order to get their votes. Good will come out of evil, however, if the lesson is brought home to the popular mind that education and politics are two things that should have as little as possible to do with one another.

THE NATURE OF SCIENCE.

WE have seldom seen the difference between the science of the ancient and that of the modern world so well drawn out as it was in the Harveian oration delivered a few weeks ago by Sir William Roberts before the Royal College of Physicians in London, England. The ancients, the speaker acknowledged, "had a large acquaintance with the phenomena of Nature, and were the masters of many inventions. They knew," he continued, "how to extract the common metals from their ores; they made glass; they were skilled agriculturists; they could bake, brew, and make wine; manufacture butter and cheese; spin, weave, and dye cloth; they had marked the motions of the heavenly bodies, and kept accurate record of times and seasons; they used the wheel, pulley, and lever; and knew a good deal of the natural history of plants and animals, and of anatomy and practical medicine." Here was a body of knowledge "of inestimable value for the necessities, conveniences, and embellishments of life." But, the lecturer went on to say, "it was not science in the modern sense of the word." Why? Because it was not "systematized and interpreted by co-ordinating principles, nor illuminated by generalizations which might serve as incentives and guides to further acquisitions." It had been acquired "mostly through haphazard discovery and chance observation," and, having no innate spring of growth, "could only increase, if at all, by casual additions—as a loose heap of stones might increase—and much of it was liable to be swept away at any time by the flood of barbaric conquest."

With the scientific possessions of the modern world the case is entirely different. They are the product of the direct and purposive efforts of the human mind, which some three centuries ago conceived the fruitful idea that the way to obtain knowledge was to go in search of it by means of observation and experiment, and not to wait for chance revelations. That idea is so familiar to us now that it is difficult to believe that it should not have been fully present to the minds of the civilized ancients. But the facts of history make it plain that it was not present to their minds. They thought acutely on many subjects, and produced an admirable literature and wonderful works of art; but they never learned the secret of interrogating Nature. Aristotle dwelt not a little on the importance of experiment and

observation; but he himself made comparatively little use of either, and his successors for many centuries, notwithstanding the extravagant authority which they assigned to his opinions, seem to have been quite uninfluenced by his suggestions on this point. They neither asked what he meant nor made any attempt worth mentioning to move forward in the direction he indicated.

Evidently the true "psychological moment," as the expression is to day, had not arrived. When it came there was, as Bacon, in words quoted by the lecturer, expressed it, "a new birth of time." Men seemed to have awaked from sleep to find themselves in possession of a new and wondrous power. They had a sense, which the ancients never had, that the discoveries they were able to make were but an earnest of greater and far more numerous discoveries yet to follow. They conceived of all the phenomena of Nature as interrelated, and foresaw that it was the destiny of human knowledge to grow into one vast, coherent, and harmonious whole. And that conception is in the world to-day, fortified by innumerable proofs derived from the victorious progress of science. The knowledge of the ancient world was unorganized, therefore it was not science: the knowledge of the modern world is organized, and therefore it is science. The knowledge of the ancient world was not a fructifying seed; the knowledge of the modern world is at once seed and harvest. The knowledge of the ancient world was not interpretative; the knowledge of the modern world symbolizes for us the powers of the universe, and the great Power in which all scattered forces find their unity. The knowledge of the ancient world was not an effectual safeguard of civilization. It is perhaps too soon to say whether modern science will safeguard the civilization we possess; but we incline to the opinion expressed by Sir William Roberts that the intellectual activity of our age and the varied excitements which act upon modern society exert, and will continue to exert, an "antiseptic" influence sufficient to prevent internal decay; while the advantage which scientific habits of thought confer upon the higher races of mankind will always suffice to secure them against such a fate as befell the civilization the Roman Empire.

BUSINESS THROUGH POLITICS.

THE recent political struggle through which the municipalities of the Empire State have passed has much more than a local significance. At a time when a very considerable part of the intelligence of the whole country has gone daft on the subject of municipal ownership and management of commercial enterprises, it seems needful to seize upon every pertinent and impressive occasion to point out the amazing folly of such social philosophy. Unless a halt be called, the tendency everywhere apparent, a tendency thought to be as wise as it is thought to be inevitable, the American people will have to pass through an experience much more ruinous and disappointing than any that they have ever yet had.

At the present time the duties intrusted to municipalities have become rather considerable. They include, first, the preservation of order and the protection of life and property; second, the paving and cleaning of streets and the construction and maintenance of sewers; third, provision for the extinguishment of fires; fourth, the support of public schools and certain charities; fifth, a department of public health; and, sixth, in some cases, a water-works system. Yet it is proposed to add

materially to these duties. The "new" social reformer has become convinced by his study of social science that municipalities should in every case have their own water-works system; that they should have their own gas and electric lighting plant; that they should own and run the street cars; that they should, in a word, take from the hands of private enterprise every industry that comes under that vague and inexact designation of "natural monopolies."

If the duties already intrusted to municipalities were performed with a skill and economy that evoked universal commendation, there might perhaps be something said in favor of their extension beyond the limit that Mr. Spencer has laid down, namely, the preservation of order and the protection of life and property. But what is the case? We venture to say that if any unprejudiced observer from another planet where the philosophy of Mr. Spencer is observed, had studied the municipal contests mentioned and were to express an opinion, he would say without the slightest qualification that it would be beyond human ingenuity to discover a more absurd, wasteful, and demoralizing method of doing business than the one through politics. Why it is that a truth so obvious does not thrust itself upon every thoughtful mind with an irresistible force is a mystery that must take high rank with the devotion of many intelligent people to Kneippism and other forms of quackery.

What was the problem that the elections were expected to solve? The assertion was made repeatedly that it was a very simple one, namely, whether public affairs were to be managed in a businesslike manner or in accordance with the interests of the politicians. As thus stated it was simple; but correctly stated it was complex in the highest degree. It was to select a large number of competent men for a large number of important duties, each requiring high character and special fitness. In the case of one city having a population of one hundred and sixty thousand, which may serve as a type, there were sixty-seven such men to be chosen, not to mention the twenty constables, the two members of the Assembly, county clerk, county superintendent of the poor, and judge of the Court of Appeals. We all know how difficult it is to select one competent man for an important duty. We know, too, how often we fail. Think how much more difficult it is to select sixty-seven! Think, too, how great the chances are of failure!

But what were the steps taken to solve this problem? Were they such as would commend themselves to the proprietors of a great New England cotton mill or a great Pennsylvania steel foundry? Before each alderman, school commissioner, member of the board of public works, etc., was presented to the voters for their suffrages, were his moral character and his capacity for the duty to be intrusted to him carefully investigated and pronounced to be up to the standard required to conduct public affairs in accordance with business principles? Let the shameless intriguing at the caucuses and conventions, the despotic dictation of some party boss that placed them upon the party ticket in disregard of their moral and intellectual fitness answer this question.

It should be remembered that with certain exceptions there were two sets of candidates of this character presented to the voter for choice. What were the steps taken to enable him to select the better of the two lots? Did he listen to speakers familiar with the personal and busi-

ness record of each candidate and intent upon making to him a candid statement of the qualifications of that candidate? Did the newspapers in the city pursue the same rational plan for the enlightenment of his puzzled mind? For answers to these questions look into the speeches delivered and the articles written. There was first the claim that the candidates of the party of virtue and ability were models of integrity and capacity; and next, that the candidates of the party of vice and incapacity were monsters of iniquity and inability. If, as sometimes happened, nothing could be urged against a candidate personally, he was charged with being either a goldite or a silverite, and therefore unfit to be mayor, or an alderman, or a school commissioner. At the same time this discussion of the merits and demerits of the several candidates was carried on with a heat and often with an absurdity of argument that made the discovery of the truth about any subject or any man absolutely impossible. Is it any wonder that the voters elected some men notoriously unfit, and defeated others of the highest character and ability?

If these statements of the problem of municipal government and the method adopted to solve it were open to question, then an enlargement of the amount of business to be done through politics might not be so absurd. But nobody impeaches their accuracy. The advocates of municipal ownership are not less vigorous in their denunciation of the evils that we have tried to describe than the opponents. When their attention is especially directed to these evils their speech becomes a prolonged jeremiad. It is only when they come to advocate what they are pleased to call in clumsy phrase the "municipalization" of gas works or street-car lines that they become optimistic and insist that cities can undertake these new duties without an aggravation of the very evils they deplore. They seem to believe that by some hocus-pocus an enlargement of the sphere of politics will transmute its inherent and unavoidable vices into virtues.

Scientific Literature.

SPECIAL BOOKS.

THE purpose of Mr. *Israel C. Russell's Volcanoes of North America** is to make clear the principal features of volcanoes in general, and to place in the hands of students a concise account of the leading facts thus far discovered concerning the physical features of North America which can be traced directly to the influence of volcanic action. The account is comprehensive as to what it includes, and accurate so far as present knowledge extends. Regarding the western hemisphere as divided into two portions, the author assigns Central America to the northern division, because its relations as to volcanoes are closer with North than with South America. For a similar reason operating inversely, the volcanoes of the Windward Islands are regarded as South American. Much of the work is derived from the results of personal observation; but, of necessity, in so large a

* Volcanoes of North America. A Reading Lesson for Students of Geography and Geology. By Israel C. Russell. New York: The Macmillan Company. Pp. 346. Price, $4.

subject, much is compiled from the works of others. The scope of the book embraces the numerous still steaming and recently extinct volcanoes of Mexico and the Central American republics, some of which have had their birth since the Spanish conquest, with examples of violent eruptions which the region furnishes; the lofty volcanic mountains of California, Oregon, and Washington, with the lava beds east of them; and still active volcanic energy in Alaska. The first chapter treats of the characteristics of volcanoes, of which the world is drawn upon for types; stages in their lives, characteristics of their products, their profiles and structure, the erosion to which they have been subjected, subterranean intrusions, and the characteristics of igneous rocks. Next is described the general distribution of the active and recently extinct volcanoes of North America. The volcanoes of Central America are enumerated, their geological relations are fixed, and they are described as "young" and "older" volcanoes, in the third chapter. The fourth chapter relates to the volcanoes of Mexico. The volcanoes of the United States are described generally through typical examples of volcanic mountains and lava sheets, and more particularly as "the great volcanic mountains of Oregon and Washington," the "Cascade Mountains," "Columbia Lava," volcanoes of the Coast Range, volcanoes of the Rocky Mountain regions, and volcanoes of Alaska. The concluding chapters are devoted to deposits of volcanic dust, and theoretical considerations, among which the interior heat of the earth, the action of pressure, the agency of water, and the chemical, mechanical, and "steam" hypotheses are noticed. The last chapter gives a very interesting description of the life history of a volcano. The book is well illustrated with charts, maps, and smaller pictures, and is supplied with a satisfactory index.

The books which for a small consideration will tell us what to eat, what to read, and even what to wear, are very plentiful; but with the exception of the pamphlet literature of the "total abstainers," whose sole interest is in water *per se* without reference to its quality, there is little information obtainable by the general reader regarding what to drink. For this reason, if for no other, such a book as the present one* ought to be kindly received. It is a treatise covering very well, in a popular way, the questions relating to the sanitation of potable waters; what water is fit to drink, the ordinary impurities, their effect on its potability, and the various methods by which the injurious contents may be removed. That the subject is an increasingly important one nobody will dispute. The growing tendency toward concentration in cities makes the water-supply question one of great difficulty, the dangers from its careless or ignorant solution being grave and far-reaching. The first chapter in the present volume gives a brief historical account of the ancient water supplies of Carthage and Rome. Drinking water and disease are next discussed. Some of the subtitles under this heading are: Paludal Poisoning, Sawdust Water, Wholesomeness of Hard Waters, Influence of Turbidity on Health, Sewage-polluted Waters, Odors and Tastes found in Waters. Chapters three and four deal with the artificial and natural purification of water. These are the most important portions of the book to the engineer and taxpayer, taking up the question of water supply in its economic and commercial

* Water Supply: Considered principally from a Sanitary Standpoint. By William P. Mason. Illustrated. New York: John Wiley & Sons. Pp. 480. Price, $5.

aspects, both as regards the general town supply and also in reference to individual household filtration. The physical forces and forms with which we have to reckon are next considered under Rain, Ice, Snow, and River and Stream Water. In these chapters are considered the importance of a pure ice supply, the influence of forests on rainfall, and the proper care of a watershed. The care and purification of stored water is next discussed, such questions as the preparation of reservoir bottoms, growth of algæ in stored water, covered reservoirs, and lake water being taken up. The important and much-disputed questions relating to ground water receive attention in chapter eight. Among the subtitles we find: Contamination by Privy Vaults, Testing Wells for Possible Contamination, Viability of Cholera and Typhoid Germs in Soil. The reliance to be placed upon Purification by Filtration through Soil, Deep-seated Water, including the driving of artesian wells, and related questions are next discussed. Then come two long chapters on the chemical and bacteriological examination of water, the quantity of per capita daily supply, and the very important question of the action of water on metals, especially its corrosion, and solution of iron and lead pipes, form the subject-matter of the two final chapters.

The book seems to be the result of much careful work, is up to date, not technical, and fairly comprehensive. It should be owned by local aldermen and trustees, and in fact every city official whose judgment may be called upon in deciding questions relating to public sanitation and water supply; even the average householder will find much of value and interest in it, and for the modern engineer and physician it seems quite an essential part of his library. Illustrations are numerous and well chosen.

GENERAL NOTICES.

THE chapter in American history relating to the cowboy, says the editor of The Story of the West Series, introducing Mr. Hough's account of that singular character of the plains,* "demands preservation for reasons æsthetic and practical alike." It concerns a feature of American life that is passing away—has, in fact, almost passed away—never to be seen again. The story has found a competent teller in Mr. Hough, who is familiar with the cowboy's life and knows how to present its most salient features in their legitimate prominence. His book is remarkably vivacious and full of incident, and his accounts are picturesque, without his having ever found it necessary to exaggerate or descend to vulgar sensationalism. While the cowboy's life has, as the editor well says, been subjected to literary abuse, literary justice is done it in this story, which treats it soberly and dispassionately without detracting from the raciness which "indolent and unscrupulous pens" have sought to impart to it by invention. First is presented to the reader "the long range," or the cattle trail from the south to the north, on which so many herds were driven twenty years ago in search of the fattening grasses of the north, how it was opened and how developed; then the cattle ranch, in the south and in the north; the cowboy's outfit and his horse, the marks and brands that were put on cattle, the rules or customs that grew up or were enacted concerning the use of grass and access to water; the occupations and incidents of the cowboy's business of tending cattle, described in several chapters; "society in the cow country," and the elements that came in to modify or disturb it—the "nester" or settler who established farms in the land; the great herders who tried to monopolize the country and fence it in, and the way

* The Story of the Cowboy. By E. Hough. (Story of the West Series.) New York: D. Appleton and Company. Pp. 349. Price, $1.50.

they were opposed; the "rustler" and "the wars of the range"; and finally the growth of settlements and the changing aspects of the country. The ten full page illustrations are based upon actual knowledge.

Prof. *L. H. Bailey's Principles of Fruit Growing* * is a comprehensive and thoroughgoing work, and appears to cover all the aspects of the subject. It does justice to the theoretical and scientific side, and is at the same time in the descriptions of the processes and appliances of fruit culture predominantly practical. The author begins with an Introductory Discussion, seeking a definition of a fruit, and finds it by enumerating the different kinds. They divide themselves into four classes, of tree fruits, vine, small, and herblike fruits, and twenty subclasses. Then he considers the geographical elements—temperature, moisture, soil, and parasite determinants—of fruit growing, the evolution of a fruit region, some economical aspects of the subject; The Location and its Climate, including site, windbreaks, and artificial protection from frost; The Tillage of Fruit Lands, their fertilization, the planting of fruit grounds, the secondary and incidental care of the plantation, diseases, insects, and spraying; and harvesting and marketing fruit. The origin of new varieties is briefly considered in the appendix, and a Bibliography of American Books on Fruit Growing is added. The author's style is direct and terse, and many of his paragraphs are very suggestive.

The great difficulty of dealing with children in disease has made this department of medicine a fertile field for the specialist. The popular notion that "almost any doctor will do for baby" is not borne out by experience. Instead of its being easier to treat a child than an adult, it is, as a matter of fact, quite the reverse, and great skill and preparation, one might almost say genius, are required for the making of a specialist in pædiatrics. Dr. Holt has given us a new work on this important subject.† He has aimed, by omitting much material which does not strictly pertain to children and which is fully treated in general medical works, to give a fuller account of the strictly infantile diseases. Another omission, which, however, seems of less doubtful propriety, is that of questions relating to operative surgery. Rather more space than is usual in a clinical work has been given to pathology. The illustrations are fairly numerous, and are for the most part original. The material, which "is largely a record of personal experience," was gathered from eleven years, continuous hospital service among young children. The work is divided into two parts. The first of these treats of the hygiene and general care of infants, and gives some rules regarding the growth and development of the body and the peculiarities of disease in children. The second part is divided into ten sections, Diseases of the Newly Born, and Nutrition being the first two section titles. The remaining sections take up in succession the diseases of the digestive, the respiratory, the circulatory, the uro-genital, and the nervous systems. Section eight deals with the diseases of the blood, lymph nodes, and bones, and section nine the specific infectious diseases. The last section is entitled Other General Diseases.

The last volume in The Contemporary Science Series to reach us is a treatise on The New Psychology,* by Professor Scripture, of Yale University. The rapid growth of popular interest in psychology and allied branches of study has produced a large recent increase in its literature, a great share of which, however, is rather doubtful science; the subject being one difficult of experimental investigation, and of so essentially personal a nature that a student only rarely succeeds in keeping his researches purely objective. Dr. Scripture takes up the study in a methodical way, using instruments and meters wherever possible, and succeeds in bringing a sort of order out of the chaos. He has aimed to show just what the new psychology is, and to make clear the fundamental ideas of the science. The first

* The Principles of Fruit Growing. By L. H. Bailey. New York: The Macmillan Company. Pp. 507. Price, $1.25.

† The Diseases of Infancy and Childhood. By L. Emmett Holt, M. D. New York: D. Appleton and Company. Pp. 1117. Price, $6.00.

* The New Psychology. By E. W. Scripture. Illustrated. Charles Scribner's Sons. Pp. 500. Price, $1.25.

part, comprising seventy-eight pages, is devoted to a consideration of methods, and is much the more important portion from a popular standpoint, because it really amounts to a discussion of the legitimacy of psychology as an experimental and exact science. The second part discusses "time" in its various psychological aspects. In Parts III and IV energy and space are respectively taken up. It will be seen from these headings that there is an attempt to divide the subject in a way analogous to that used in the study of physics. The last thirty pages of text, entitled Past and Present, give a brief history of the methods, speculations, and men connected with the study of psychology since the days of the Greeks. The book contains numerous drawings and illustrations, and several useful tables and formulæ, as appendices.

Mr. *Bullock's Introduction to the Study of Economics* * fulfills well the exact purpose implied in its title. The first three chapters —which relate to the growth of the United States and their population, their land tenures and systems of labor, the growth of their foundational institutions, of the fur trade, cattle raising, fisheries, and mining, and manufactures and transportation—aim to familiarize the student with an orderly treatment of some leading facts in the economic history of the United States before the study of economic theory is begun. Throughout the book economic principles are discussed with special reference to American conditions, and their workings are illustrated by frequent allusions to American experience. The subjects of wealth, its consumption, production, and distribution, exchange, money, credit, bimetallism, monopolies, international trade, wages, land nationalization and socialism, and the economic functions of Government are thus treated; while public finance has been only incidentally touched upon, and it has not been considered expedient to attempt to discuss taxation within the special limits of the volume. We have been much struck with the clear presentation made of principles and doctrines, of the strong common sense that pervades the author's observations, and the general soundness of his views. A bibliography of the special subject is given at the close of each chapter, and a general bibliography of twenty-five pages and a copious index will be found at the end of the book.

The *Natural History* of the Concise Knowledge Library * is an admirable example of the manner in which much information may be presented satisfactorily in a small space. It is a book that may be held in the hand and is legibly printed, yet it covers the whole animal kingdom, and each department is treated by an expert in it, distinguished as an authority and an original investigator. It well fulfills its aim, as defined in the preface, to be concise and popular, at once accurate in statement, handy in form, and ready of reference. While giving all the technical names, the authors have sought to express themselves as much in English as possible. Hence in the text the technical terms are rendered in their English equivalents, or, where there are none such, explained in the vernacular in such a way that the most unlearned may understand what is meant. Mr. Lydekker even goes so far as to apologize for using so little technical a word as "mammals," because it has no English equivalent, "beasts" excluding man, and quadrupeds excluding man and the higher apes, and including lizards, etc. The text is preceded by a concise systematic index, giving the complete classification, and followed by an alphabetical index, containing about ten thousand references and occupying forty-six pages.

The rapid onward march of science has made necessary the revision of what was a thoroughly up-to-date book on optics † fifteen years ago. The changes we find in the new edition of Professor Le Conte's "Sight," are mainly in the form of additions. The principal of these are in Part I: a fuller expla-

* Introduction to the Study of Economics. By Charles Jesse Bullock. Boston, New York, and Chicago: Silver, Burdett & Co. Pp. 571. Price, $1.28.

* The Concise Knowledge Library: Natural History. By R. Lydekker, R. Bowdler Sharpe, W. F. Kirby, W. Garstang, B. B. Woodward, F. A. Bather, R. Kirkpatrick, H. M. Bernard, and R. I. Pocock. New York: D. Appleton and Company. Pp. 771. Price, $2.

† Sight. An Exposition of the Principles of Monocular and Binocular Vision. By Joseph Le Conte. New York: D. Appleton and Company. Pp. 318. Price, $1.50.

nation of the cause of astigmatism, a clearer statement of the nature of space perception and the law of direction, a new mode of locating in space the visual representative of the blind spot, a brief account of "visual purple" and its probable function, and a much fuller exposition of color perception and color blindness. There is little change in Part II. Part III, where Professor Le Conte's own views are especially set forth, has been carefully gone over and verified. There have also been added a chapter on the form of phantom planes under certain conditions, and a final chapter on the evolution of the eye. Illustrations and diagrams are numerous. For a full notice of the original volume our readers are referred to the June issue of 1881.

The Sixth Annual Report of the Tennessee Bureau of Labor Statistics and Mines for 1896 calls especial attention to the growth of Tennessee as a mining and industrial State. It is shown that her mineral production was never before so large; that there has been a marked improvement in the condition of the mining properties; and that, notwithstanding the large increase in output, the number of accidents has been markedly decreased. Among the special articles we find the following titles: The Manufacture of Coke; Pig-iron Industry in 1896; Zinc, Lead, and Copper; the Phosphate Industry; and the Petroleum Field of Tennessee.

Part II of *The Report of the Alabama State Geologist* has recently reached us. It describes the so-called Coosa Valley region, Part I treating of the Tennessee Valley region. The topographic, geologic, and economic features are all considered. The geology of this section is especially difficult, because of the number of formations involved and their complexity of structure. The large economic interests here, however, make the study one of great value. The volume contains an interesting and instructive map of structure sections through various portions of the State.

Crime and Criminals (Chicago: W. T. Keener Co., $1) is substantially a reproduction of a series of articles contributed by the author, *J. Sandersen Christison*, under the title of Jail Types, to a Chicago journal. They are given in book form in response to the favorable notices they receive. They consist of sketches—life histories with characterizations of individual criminals, with photographic profile and full-face portraits. The author suggests that those who read them may find much to reflect upon in the line of duty as members of society at large. The delinquents are regarded, from the psychological point of view, as belonging to the three classes of the insane, the moral paretic, and criminals proper.

In *The Science of Speech* (Washington: The Volta Bureau) *Alexander Melville Bell* offers an explanation of all the actions of the mouth and the vocal organs which produce speech. While in the system of visible speech the elements of language are exhibited in symbols, by which some beginners may be deterred, in the present work the same elements are described without symbols, with the formation of the sounds expressed in the nomenclature. Hence the author styles it a species of shorthand for the mechanism of utterance.

The sixth volume of the *Report of the Iowa Geological Survey* (*Samuel Calvin*, State Geologist) includes the reports on Lead and Zinc Deposits, by A. G. Leonard; The Sioux Quartzite and Certain Associated Rocks, by S. W. Beyer; the Artesian Wells of Iowa, by W. H. Norton; and the Relations of the Wisconsin and Kansas Drift Sheets in Central Iowa, and Related Phenomena, by H. Foster Bain. The lead and zinc deposits extend along the Mississippi River for nearly eighty miles, in the counties of Dubuque, Clayton, and Allamakee. Mr. Norton's paper on Artesian Wells is a full and elaborate study of the subject.

The *Bulletin of the United States Fish Commission*, Volume XVI, for 1896 (*John J. Brice*, Commissioner), contains a report, by Barton W. Everman, upon Salmon Investigations in the Headwaters of the Columbia River, in the State of Idaho, in 1895, together with notes upon the fishes observed in that State in 1894 and 1895; and papers on the Artificial Propagation of the Rainbow Trout, by George A. Beagle; The Russian Fur Sea Islands, by Leonhard Stejneger; The Artificial Propagation of Salmon on the Pacific Coast of the United States, with Notes on the Natural History of the Quinal Salmon,

by Livingston Stone; and Deep-Sea Exploration, with a general description of the steamer Albatross, her appliances and methods, by Z. L. Tanner.

The *Fourteenth Annual Report of the Bureau of Ethnology* for 1893–'94 (*J. W. Powell*, Director) presents the results of a full year of study by the members of the Bureau, the publication of which in book form has been so delayed that they are hardly longer new to the public, and several authors whose works are referred to in the administrative report—Mallery, Pilling, Dorsey, among them—have died. The administrative report gives a clear account of the classification of the work of the bureau, and of the labor of its agents in various fields, showing that a large amount of information is being accumulated, while the original and living sources are still accessible, which might, if the studies were long delayed, be irrecoverably lost, and which is destined to be of incalculable value to students of mankind. The special papers, published in full with ample illustration, are Stone Implements of the Potomac-Chesapeake Tidewater Province, by W. H. Holmes; The Siouan Indians, a Preliminary Sketch, by W J McGee; Siouan Sociology, a Posthumous paper, by J. O. Dorsey; Tusayan Katcinas, by J. W. Fewkes; and The Repair of Casa Grande Ruin, Arizona, by Cosmos Mindeleff.

Part second of Volume XXVI of the Annals of the Astronomical Observatory of Harvard College, comprising *Miscellaneous Investigations of the Henry Draper Memorial*, gives first a Review of Progress during the Years 1891 to 1894, followed by accounts of Observations on the Distribution of Stars in Clusters, Measurement of Positions and of Brightness and Spectra of Stars in Clusters. These articles are illustrated by eleven excellent photographic plates, recording and communicating to the eye what was seen.

The *Seventeenth Annual Report of the United States Geological Survey*, covering the work of the fiscal year 1895–'96, is published in two parts, constituting two very large volumes of 1076 and 864 pages. The first part, besides the director's report, in which the work of the various branches of the survey is described, contains papers on Magnetic Declination in the United States, by Henry Gannett; A Geological Reconnoissance of Northwestern Oregon, by J. S. Ditler; The Geology of the Sierra Nevada, by R. W. Turner; The Coal and Lignite of Alaska, by W. H. Dall; Glacial Brick Clays of Rhode Island and Southeastern Massachusetts, by N. S. Shaler and others; and the Eocene and Upper Cretaceous of the Pacific Coast, by T. W. Stanton. The second part contains papers on the Gold Quartz Veins of Nevada City and Grass Valley, by Waldemar Lindgren; Geology of Silver City and the Rosita Hills, by W. Cross; the New and Kanawha Rivers, by M. D. Campbell and W. C. Mendenhall; The Underground Water of the Arkansas Valley, by G. K. Gilbert; The Water Resources of Illinois, by Frank Leverett; and Artesian Waters of a Portion of the Dakotas, by N. H. Denton.

Extension Bulletin No. 20 of the University of the City of New York is also Public Libraries Bulletin No. 6, and embodies the report of the Public Libraries Division for 1896, including statistics of New York libraries.

The *Bulletin* of the Department of Labor for September, 1897, contains articles on the inspection of factories and workshops in the United States; the mutual rights and duties of parents and children; the municipal or co-operative restaurant of Grenoble, France; digests of recent reports of five State Bureaus of Labor Statistics and of recent foreign statistical publications; decisions of courts affecting labor; and recent State laws relating to labor.

The *Report of the Chief of the Weather Bureau* for the year ending June 30, 1896, besides the usual meteorological tables and related matter for the year, briefly treats of new work undertaken with a view of improving the bureau service, special improvements made during the year, and the preparation and distribution of forecasts and warnings. Noticeable features are the paragraphs about observations with kites and international cloud observations, and the paper, illustrated with charts, on tornadoes since 1889.

To their Library of Useful Stories D. Appleton and Company add *The Story of the Earth's Atmosphere* (price, 40 cents), in which the author, *Douglas Archibald*, of the Royal

Meteorological Society, London, seeks to put forward the main features of our knowledge of the conditions that prevail in the atmosphere as they are interpreted through the science of to-day. He has written not for the minority, who vaguely wonder at the relation of extraordinary facts and pass on, but for the more numerous class who, besides the facts, want to know the reason why. In successive chapters he presents briefly in clear style the different qualities, phenomena, and operations of the atmosphere, including precipitation, storms, sounds, and colors, and devotes a chapter to flight and another to life in the atmosphere. The latest developments of exploration by kites are explained.

The *Report of the Commissioner of Education* for 1895–'96, besides the usual departmental information and national and State statistics, contains many papers of value and interest; among which we mention those on laws relating to city school boards, education in various European and South American countries, schools in certain Middle and Southern States during the first half of the century (by A. D. Mayo), music in German schools, libraries and library legislation, the Fifth International Prison Congress, Jewish schools two thousand years ago, correlation of studies, a biography and bibliography of Horace Mann, and an article that savors much of old times and is, withal, very entertaining, on early educational life in middle Georgia.

PUBLICATIONS RECEIVED.

Academy of Natural Sciences of Philadelphia. Proceedings. April to September, 1897. Pp. 176, with plates.

Agricultural Experiment Stations. Bulletins and Reports. Ohio: No. 85. Strawberries. By W. J. Green. Pp. 24; No. 86. The Story of the Lives of a Butterfly and a Moth. Pp. 10; Newspaper Bulletin, No. 178. The San José Scale and the Periodical Cicada. Pp. 21.—Purdue University, Lafayette, Ind.: Tenth Announcement of the Winter School of Agriculture.—United States Department of Agriculture: Notes on the Grasses and Forage Plants of Iowa, Nebraska, and Colorado. By L. H. Pammel. Pp. 47.

American School of Metaphysics. L. E. Whipple, Principal. Prospectus. 272 Madison Avenue, New York. Pp. 48.

Blackford, C. M., Jr., M. D., Atlanta, Ga. Prize Essay on the Present Status of Serum Therapy. Pp. 16.

Bourgognon, A. Physical Problems and their Solutions. New York: D. Van Nostrand Company. Pp. 222. 50 cents.

Brown, D. W. An Attempt at a Synthetical Demonstration of the Primary Problems of the Differential Calculus. Pp. 20.

Bruce Photographic Telescope. Plates of Nebulæ and Star Clusters. Three plates.

Bureau of American Republics. Code of Commercial Nomenclature—English, Spanish, and Portuguese. Three volumes. Pp. 670, 645, 640.

Call, R. Ellsworth. The Hydrographic Basins of Indiana and their Molluscan Fauna. Pp. 12; The Evolution of the Map of Mammoth Cave, Kentucky. Pp. 6, with plates.

Curtis, Carlton C. A Text-Book of General Botany. New York: Longmans, Green & Co. Pp. 359. $3.

Dawson, George M. The Physical Geography and Geology of Canada. Toronto: Howell & Hutchinson. Pp. 48; Some Observations tending to show the Occurrence of Secular Climatic Changes in British Columbia. Ottawa: J. Durie & Son; Toronto: The Cobb Clark Company. Pp. 8.

Deane Pumping Machinery Catalogue, 1897. Holyoke, Mass. Pp. 181.

Gilman, Daniel C. Semicentennial Historical Address at Sheffield Scientific School, New Haven, Conn. Published by the School. Pp. 40.

Groner, D. A. N. What is the Force of Gravitation? Kansas City, Mo.: The Acme Publishing Company. Pp. 58.

Haviland, F. W. Science. The Ancient Hebrew Significance of the Book of Genesis. New York: The Author, 205 West One Hundred and Eighteenth Street. Pp. 186. $1.

Heilprin, Angelo. Map of the Arctic Regions, comprising the most Recent Explorations of Peary, Nansen, and Jackson. Geographical Society of Philadelphia.

Iowa Geological Survey. Annual Report, 1896, with Accompanying Papers. Samuel Calvin, State Geologist; J. G. Leonard, Assistant. Des Moines. Pp. 555.

Johns Hopkins University Circulars. November, 1897. Pp. 21. 10 cents.

Mach, Ernst. Popular Scientific Lectures. Translated by T. J. McCormack. Second edition, revised and enlarged. Chicago: Open Court Publishing Company. Pp. 382. $1.

Means, D. McM. Industrial Freedom, with an Introduction by the Hon. David A. Wells. New York: D. Appleton and Company. Pp. 248.

Merrill, F. J. H. Geological Map of a Part of Southeastern New York, showing the Distribution of Stones used as Building Stones. Albany: New York State Museum.

Newland, A. F., and Row, R. K. The Natural System of Vertical Writing. Six graded books, with a Teacher's Manual. With a Monograph by C. H. Ames. D. C. Heath & Company. Price of each book, 75 cents per dozen.

Olmstead, D. H. The Protestant Faith; or, Salvation by Belief. Third edition. New York: G. P. Putnam's Sons. Pp. 80.

Parker, Francis W., and Helm, N. L. Uncle Robert's Visit. New York: D. Appleton and Company. Pp. 191.

Peabody Education Fund. Proceedings of the Trustees at the Thirty-sixth Meeting, 1897. Pp. 65.

Roché, Georges. La Culture des Mers en Europe (Cultivation of the Seas in Europe). Paris: Félix Alcan. Pp. 328. 6 francs.

Scovill & Adams Company, of New York. The American Annual of Photography and Photographic Times for 1898. Pp. 370. 75 cents.

Seitz, J. A. The Colloquy (Poem). New York: G. P. Putnam's Sons. Pp. 226. $1.75.

Somatose. American Biscuit and Manufacturing Company, New York.

Star, The, of No. 6 (Grammar School). New York. Monthly. Pp. 8.

Teall, F. H. Punctuation. With Chapters on Hyphenization, Capitalization, and Spelling. New York: D. Appleton and Company. Pp. 193. $1.

Thompson, Edward B. The Chultunes of Labria, Yucatan. Cambridge, Mass.: Peabody Museum. Pp. 20, with plates.

Troeger, J. W. Harold's First Discoveries. New York: D. Appleton and Company. Pp. 93. 25 cents.

United States Commissioner of Labor. Ninth Special Report. The Italians in Chicago. Washington. Pp. 409; Bulletin of the Department of Labor. November, 1897. Pp. 108.

United States Geological Survey. Geologic Atlas of the United States. Yellowstone National Park Folio. Wyoming. Pp. 6 letterpress, and 7 single- and double-page plates.

United States Commission of Fish and Fisheries. A Manual of Fish Culture. Washington. Pp. 340, with thirty-five plates.

United States Hydrographic Office. Classification of Clouds. Chart in colors.

University of the State of New York. Regents' Bulletins. No. 38: Laws, Ordinances, and By-Laws. Pp. 104. 15 cents; No. 42: Fifteenth University Convocation. Pp. 212. 25 cents.

Vail, I. N. Alaska, Land of the Nugget. Why? Pp. 68. 50 cents.

Waller, Augustus D. Lectures on Physiology. Animal Electricity. New York: Longmans, Green & Co. Pp. 144. $1.50.

Wilson, Mrs. L. L. W. Nature Study for Elementary Schools. New York: The Macmillan Company. Pp. 262. 90 cents.

Wright, G. F. Scientific Aspects of Christian Evidence. New York: D. Appleton and Company. Pp. 362. $1.50.

Wright, Mabel Osgood. Bird Craft: A Field Book of Two Hundred Song, Game, and Water Birds. New York: The Macmillan Company. Pp. 313. $2.50.

Fragments of Science.

Chinese White Wax: a Curious Industry.—George F. Smithers, consul at Chung-king, China, is authority for the following: In the Chien-ch'ang Valley, and especially in the neighborhood of Chung-king, which is the chief wax-producing country, perhaps the most prominent tree is the *Ligustrum lucidum*, or "insect tree." It is an evergreen, with dark-green, glossy, ovate leaves springing in pairs from the branches. On these trees, attached to the bark, are numerous brown, pea-shaped excrescences. The larger of these scales are readily detachable, and when opened present either a whitish-brown pulpy mass, or a crowd of minute animals looking like a mass of flour. Upon close examination these masses are found to consist of a swarm of brown or dirty-white creatures, each provided with six legs and a pair of antennæ. This is the white-wax insect, the *Coccus pe-la* of Westwood. Many of the scales also contain either a small white bag or cocoon covering a pupa, or a perfect imago in the shape of a small black beetle. This beetle is a species of *Brachytarsus*. If left undisturbed in the broken scale, the beetle, which from his ungainly appearance is called by the Chinese *niu-érh* (buffalo), will continue to burrow in the inner lining of the scale, which is apparently his food. The Chinese declare that the beetle eats his minute companions in the scale. When a scale is plucked from a tree, an orifice where it was attached to the bark is disclosed. By this orifice the cocci are enabled to escape from the detached scales. Two hundred miles to the northeast of Chien-ch'ang, and separated from it by a series of mountain ranges, is the prefecture of Chia-ting, within which insect white wax as an article of commerce is produced. At the end of April the scales are gathered from the trees, made up into paper packets, each weighing about sixteen ounces, and transported by porters across the mountains to Chia-ting. Great care has to be taken in the transit of the scales. The porters travel only during the night, as the high temperature during the day would cause a too rapid development of the insects and their escape from the scales. Notwithstanding the greatest precautions, however, each packet loses about an ounce in transit. West from the right bank of the Min River, on which the city of Chia-ting lies, stretches a plain to the foot of the sacred O-mei range of mountains. This plain is an immense rice field, being well watered by streams from the western mountains. Almost every plot of ground here, as well as the bases of the mountains, are thickly edged with stumps, varying from two or four to a dozen feet in height, with numerous sprouts rising from their gnarled heads. These stumps resemble at a distance our own pollard willows. The leaves spring in pairs from the branches; they are light green, ovate, serrated, and

deciduous. It is probably the *Fraxinus chinensis*, a species of ash. The tree is known to the Chinese as *pai la shu* (white-wax tree). On the arrival of the scales from the Chien-ch'ang Valley, they are made up into small packets of from twenty to thirty scales, each inclosed in a leaf of the wood-oil tree. The edges of the leaf are tied together with rice straw, by which also the packet is suspended close under the branches of the wax tree. A few holes are made in the leaf, so that the insects may find their way through them to the branches. On emerging from the scales the insects creep along the branches to the leaves, where they stay for a period of thirteen days. They then descend to the branches and twigs, the females probably to provide for a continuation of the race by developing scales in which to deposit their eggs, and the males to excrete the substance known as white wax. Whether or not this wax is normally intended as a protection for the scales is uncertain. The wax first appears as a white coating on the under sides of the boughs and twigs, and looks very much like sulphate of quinine. It gradually spreads over the whole branch, and attains after three months a thickness of about a quarter of an inch. The branches are then lopped off and as much of the wax as possible removed by hand. This is placed in a pot of boiling water. The wax, melting, rises to the surface, is skimmed off, and placed in a round mold, whence it emerges as the white wax of commerce. An inferior darker quality is made by boiling twigs and all together. When the branches are lopped off a wax tree, a period of three years is allowed to elapse before the tree is again used. Since the introduction of kerosene oil into China the use and hence production of this wax have much decreased, it having been largely used as an external coating for candles on account of its high melting point (160° F.).

Psychic Development of Cats and Dogs.—Prof. Wesley Mills's experiments on the psychic development of young animals continue to be very interesting. In the kitten, while the first stages are very slow and obscure, the author finds that in the progress of all the senses to full development the course, while marked by definite steps, is often so rapid that distinct advances may be marked in a single day. Apart from the senses, etc., there seems to be a definite order in which all the features of feline nature appear, as, for instance, purring, crouching, stalking, etc. Certain physical changes are correlated in time with certain psychic developments, the significance of which is in some cases clear, in others obscure. Comparing the two animals, the cat, on the whole, develops more rapidly than the dog, the greatest difference between them appearing in the social and gregarious nature of the dog and the independent and solitary traits of the cat. The dog is docile in the highest degree; the cat to a slight degree, compared with its intelligence. The play instinct is early and highly developed in both, and the peculiar qualities of each are well exhibited in the manifestation of it. In will power and ability to maintain a separate existence the cat is superior to the dog. In the higher grades of intelligence the wisest dogs are much in advance of the most knowing cats; and this is foreshadowed if not exemplified in the early months of existence. The nature of the dog as compared with the cat tends to beget prejudices in his favor with the mass of persons, so that in general the dog is overestimated and the cat underestimated with the great majority; at the same time the dog's nature is much nearer that of man than the cat's. "The kitten may amuse, but even a puppy dog touches chords of sympathy in the heart of man that the cat can never reach."

An Incandescent Oil Lamp.—Ever since the successful introduction of the incandescent mantle in gas lamps, inventors have been hard at work trying to construct an oil lamp which could be used to replace the gas in heating the mantle. Many such lamps have been contrived, but up to the present time none of them have proved satisfactory. It is now announced, however, in Industries and Iron, that such an oil lamp having an atmospheric burner has recently been offered for inspection in London, which seems to be free from most of the defects of its predecessors, and which promises to become a great commercial success. It is called the "Era" incandescent petroleum burner, and consists of a "gallery burner," spreader, mantle, and chimney—in fact, everything

necessary except the oil container. The mantles are of special form, being somewhat shorter and apparently broader than those used for coal-gas burners, and the mesh of the material is more open. It is claimed that the lamp will give a fifty-candle light, with rather less than one third the oil consumption customary with a burner of the ordinary type having equal illuminating power. The air blast, which is necessary for converting the luminous flame into a heating one, is secured by the use of an unusually long chimney. The adjusting of the flame to its proper height is effected by the ordinary rack mechanism operating on the wick case and wick. If the flame is too high it begins to "sing," and this serves as a ready means for regulating it. It is stated that the complete apparatus, with spare gallery and cap, is sold retail at about $2.40, and can be fitted to any type of lamp having a fourteen-line cylindrical burner.

Chemistry of a Silk Jacket.—Dr. T. L. Phipson has recently had occasion to analyze a piece of black dress silk of medium quality, at the request of a lady who wished to ascertain its value. The results are curious. The material contained a large quantity of substance that was not silk at all, being considerably "weighted." It would not burn with flame, but smoldered away like tinder and left a large amount of ash, the principal ingredient of which was oxide of tin. The precise composition was: Water, 11·43 parts; ash (mostly oxide of tin and silica), 14·30; real silk, 28·14; organic matters, etc., not silk, 46·13; in all, 100 parts; nitrogen, 4·76 parts. Respecting the tin, the author observes that he has examined specimens of poor tin ore from Cornwall that did not contain more tin than this material for a lady's blouse; "and I at once realized the fact that the silk dresses worn by the ladies we see daily parading in Regent Street and Bond Street, taken together, would represent a Cornish mine of very fair quality." The analysis brought to light the fact that the durability of a piece of silk can be determined by this method. The probable life—that is, the length of time before it would become "utterly shabby, greasy-looking, and showing the threads"—was estimated by a milliner at about three months. It is said, however, that the public prefer the cheap products that get shabby so soon because the fashions change so rapidly that it would be useless to buy silk of better quality.

A Primitive Maya Jewsharp.—Mr. M. H. Saville gives the following interesting information in a recent note in the American Anthropologist: The ancient forms of musical instruments known to have been used in Yucatan have been almost entirely superseded by those introduced since the Spanish conquest. In some of the interior pueblos the *tunkul*, or ancient wooden drum, is still used on feast days. "During the winter of 1890–'91, while engaged in explorations at the cave of Loltun, we employed a number of Mayas who came from small villages in the interior remote from Spanish influences. Their evenings were passed in singing plaintive melodies in their native tongue, accompanied by a primitive form of stringed instrument which I have never seen described. It was called *hool*, and consisted of a piece of ropelike vine (*ohil*) stretched between the two ends of a pliable stick, making a bow about two feet long. One end of this bow is placed near the face, about one third of the distance from the end, so that the mouth covers but does not touch the string, forming a resonator. Between the string and bow a piece of wood is placed in such a manner that it may be pressed against the string or relaxed at will. The tones are produced by tapping on the string, and somewhat resemble those made in playing a jewsharp, but are more agreeable to the ear. Variation of tone was produced by varying the pressure of the stick upon the string and also by the opening or partial closing the mouth. The music is weird and not unpleasing."

The Jesup Expedition.—The object of the Jesup expedition to the North Pacific, as explained by Prof. F. W. Putnam in the British Association, is to study the question of the supposed Asiatic origin of the ancient American peoples. The whole cost of the expedition is to be paid by Mr. Morris K. Jesup. A thorough and careful exploration will be made of both sides of the Pacific Ocean north of the Columbia River in America

and of the Amoor in Asia. Several parties will be placed in the field, each including a thoroughly qualified ethnologist, a physical anthropologist, and an archæologist, who will make comparative studies of the physical characteristics of the different peoples, their languages, their myths and traditions, their customs and arts, and will also study the archæology of the whole region. Dr. Boas has been in the field since June, 1897, in British Columbia, and has established four parties, who are working under his immediate direction. The first party will go to Asia in the spring, and other parties will be put into the field from time to time as the men are selected who are properly prepared for the work. In the discussion which followed the presentation of this account, Professor Putnam expressed his belief that there had been an American-Asiatic contact. Mr. Frank H. Cushing was of a different opinion, and thought that the resemblances between the arts and customs of aboriginal Americans and Asiatics were merely the results of similar psychic developments under corresponding environments. Professor Morse brought forward data that led him to the conclusion that not a dialect, art, tool, or weapon was found in America at the time of the discovery that had been in use in the Old World.

Object Lessons in Road Building.—The following, in a circular of information from the New York Agricultural Experiment Station at Geneva, will be of value to all interested in the good-roads problem: The attempt to stimulate and inform the public mind in the direction of good roads is being undertaken in two ways: first, by the distribution of good roads literature; and, second, by the building of sample roads in connection with State colleges and experiment stations. The first sample road to be built is already completed at New Brunswick, N. J. (this was written about the first of August), and the second one, which is being constructed in connection with the Geneva station, is now in its first stages. This sample road, which has been made possible through the generosity of private citizens and through liberal aid from the town and city of Geneva, will be over seven thousand feet long, being located in an important street which connects the experiment station with the city. A section of this, perhaps eight hundred feet, will be macadamized in the center to the width of eight feet, with rolled dirt roads on either side, this being designed as an improved country road. The remainder, something over a mile, will be macadamized in the center fourteen feet, with dirt roads on either side. It is now also proposed to lay at least two hundred feet of the steel track which is now attracting so much attention as a possible efficient and economical road in sections where stone is scarce and costly.

A Troublesome "Water Weed."—About seven years ago a few plants of the water hyacinth were accidentally thrown into the St. John's River in Florida. Since then they have increased so enormously as to prove a serious obstruction to navigation, so much so indeed that about two years ago it was found necessary to call in the aid of the War Department. Still later, in the early part of 1897, the Department of Agriculture sent one of its agents, Mr. Herbert Webber, to the region in order to investigate more fully the physiology and habits of this dangerous vegetable. His report has been recently published and is authority for the following statements: The plant grows chiefly in sluggish fresh water, the character of the water seeming to have much to do with its growth. It can not live in brackish water, and is promptly killed when it is dislodged and floats down into salt water. It is normally propagated by seeds and stolons. When the plant first appeared in the river its beautiful masses of flowers were much admired, and it was introduced at various points for its beautifying effect. At this time no one expected the plant would become a nuisance. In a very short time, however, it began to seriously interfere with navigation, and its effect on the lumber and fishing industries has been most disastrous. It is feared that its eradication is impracticable.

Unexplained Tidal Variations.—It has been demonstrated by Lord Kelvin and Professor Darwin that the tidal movement is made up of many waves, depending upon different functions of the moon and sun. Some of these movements are half daily, some daily. The tidal movement is nowhere

more simple and regular, says Captain W. J. L. Wharton, than in the British Isles, in remarkable contrast to the opposite American coast, where it is very complicated. The minor tides, which in most parts of the world considerably affect the volume of the whole, are in Great Britain comparatively insignificant; why, is not yet explained. Some curious interference phenomena originating in the meeting of tidal waves from opposite directions, or in rebounds from the coasts, have been observed in the British Isles. The tidal range of about fifteen feet on the western part of the southern coast of England diminishes as we go eastward to one of six feet near Poole, then increases to Hastings, where it is twenty-four feet, and then, farther east, gradually diminishes. This is due to reflection from the French shores, which brings waves that here re-enforce, there reduce, the main wave, according to details so complex that they have not yet been studied out. Variations in the mean range of tides on many coasts may be accounted for as resulting from such reflections, which may come from longer distances and be more numerous than we are now aware of.

Toads at Dinner.—The toad does not take dead or motionless food. Only living and moving insects, centipeds, etc., are devoured, while worms or other larvæ disturbed by their hopping are safe so long as they remain curled up; but as soon as they move they are captured. The toad's tongue, its only organ for seizing food, is soft, extensile, attached in front but free behind, and is covered with a glutinous substance that adheres firmly to the food seized. So rapid is the motion of this weapon that a careful watch is necessary in order to see the animal feed. At night, soon after sunset or even before on cool evenings, the toad emerges from its shelter and slowly hops about in search of food. Something of a regular beat is covered by these animals, whose sense of locality is strong. In the country this beat includes forage along the roadside, into gardens and cultivated fields, and wherever insect food is abundant and grass or other thick herbage does not interfere with getting about. In cities and suburban villages the lawns, walks, and spots beneath the electric lamps are favorite hunting grounds. At Amherst, Mass., Mr. A. H. Kirkland, from whose paper we derive these observations, once counted eight large, well-fed toads seated under an arc light and actively engaged in devouring the insects which, deprived of wings, fell from the lamp above. At Malden, Mass., a colony of about half a dozen toads sally forth on summer evenings from under the piazza of a citizen's house, go down the walk, cross the street, and take up their stations under the arc lamp, where they feed upon the fallen insects till the current is turned off, when they return to their accustomed shelter.

Unexplored Regions in Asia.—In the coming century there will be abundance of work for explorers in Asia, said Dr. J. Scott Keltie in the British Association, and plenty of material to occupy attention. They lie in two separate regions. In southern and central Arabia there are tracts which are entirely unexplored. These regions are probably a sandy desert. At the same time they are, in the south at least, fringed by a border of mountains, whose slopes are capable of rich cultivation, and whose summits the late Mr. Theodore Bent found to be covered with snow. If any traveler cared to face the difficulties, physical, political, and religious, which would probably be met with, he might be able to tell the world a surprising story. Another region in Asia where real pioneer work still remains to be done is Tibet and the mountainous districts bordering it on the north and east. Lines of exploration have in recent years been run across Tibet by Russian expeditions like that of Prejevalsky, by Rockhill, Prince Henry of Orleans, Bonvalot, Bower, Littledale, Wellby, and Malcolm. From the results obtained by these explorers we have formed a fair idea of this, the most extensive, the highest, and the most inhospitable plateau in the world The forbidden city of Lassa is at present the goal of several adventurers, although as a matter of fact we can not have much to learn in addition to what has been revealed in the narrative of the native Indian traveler, Chandra Das. The magnificent mountain region to the north and east of Tibet furnishes a splendid field for the enterprising explorer. Then there are the series of parallel mountain chains southeast of Tibet through which the upper waters

of the great eastern Asiatic rivers run; a region in Turkestan; the Malay Peninsula; and the great islands of the Malay Archipelago and the Philippines.

MINOR PARAGRAPHS.

THE last bulletin of the Hatch Experiment Station gives some interesting information regarding the nitrogen germ fertilizer. Hellriegel and his colaborers have established by careful observation the fact that leguminous plants, like clovers, beans, vetches, lupines, etc, with the assistance of certain root bacteria found in the soil, can utilize the nitrogen of the air for the formation of nitrogen plant food fit for the support of their growth. These micro-organisms fasten themselves upon the roots of the clover, penetrate the epidermis, and form in the course of their growth swellings, nodules, or tubercles of varying size or shape. Their presence and growth in the tissue of the roots of this class of plants are considered an essential condition for the conversion of the elementary nitrogen of the air into suitable nitrogen plant food. One of the latest developments in this direction is the appearance in the general market of patented germ fertilizers for leguminous crops.

THE crude materials for the manufacture of carborundum at Niagara Falls are sand, coke, sawdust, and salt. These are ready for use except the coke, which has to be ground to a fine powder. The furnaces are built of brick and have the form of an oblong box about sixteen feet in length and five feet in width and depth. In the center of either end are the terminals, consisting of sixty carbon rods thirty inches long and three inches in diameter. The mixture is thrown into the furnace, connection made with the dynamo, and after twenty-four hours the process is complete. The carborundum occurs in the center of the mixture as bright radiating crystals. In order to prepare the carborundum for the market it is first placed under heavy iron rolls for the purpose of crushing apart and separating the individual crystals, which are then washed in a solution of acid and water to remove solubles, and finally dried and sifted to separate the different-sized crystals. During the year 1896 the carborundum company produced in round numbers 1,191,000 pounds of crystalline carborundum. Carborundum is used chiefly as an abrasive, for which it is especially well suited, owing to its excessive hardness, which closely approaches that of the diamond.

AN interview with the physician in ordinary to the living Buddha of Ourga educed the following statements regarding Mongolian medicine: Mongols do not dissect, hence their anatomical knowledge is very limited. They fix the number of diseases at four hundred and forty. Works on medicine are very numerous, the chief one being a kind of encyclopædia entitled *Khlantap*. Their methods of physical examination are like Sam Weller's knowledge of London, "extensive and peculiar." Thus more than seventy varieties of pulse are described. Urine analysis is insisted on, and sometimes extends as far as tasting. Their pharmacopœia is mainly composed of vegetable substances. Aromatic plants, such as cinnamon and benzoin, play a large part in their therapeutics. The true medical man is not allowed to practice surgery, but in cases of crushed limbs where amputation is necessary, the physician may direct a butcher how to use the knife.

THE pre-Columbian inhabitants of Mexico and Central America made very durable paper from the leaves of the maguey or century plant. In one of the records preserved upon this paper we are informed that twenty-four thousand reams of it were to be brought yearly as tribute to the storehouses of the ruler of Mexico—Tenochtitlan. Two cities are named as the principal places of manufacture, Yzamatillea and Amacoztilla. The people used the paper not only for books, but, like the Japanese and Chinese, for flags, banners, ribbons, clothing, etc. It was prepared by soaking and macerating the leaves of the maguey, and then beating them into thin sheets, which were either varnished or coated with animal membranes. The codices, or Aztec and Mayan records, were printed on long, narrow strips and then

folded up like a screen, with a board cover at each end. Both sides of the paper were used.

NOTES.

TILL about two years ago all the fuller's earth used in this country was imported. About that time deposits were discovered in Florida. After these, a paper by Mr. Heinrich Ries says the most extensive beds so far found have been in South Dakota. At Fairburn the earth passes upward into the sandy clay, but in its purer portions is a yellowish, gritty clay, with a somewhat nodular structure. The individual nodules are dense, and break with a conchoidal fracture. The earth at Argyle is exactly similar to this, but that at the Minnekahte beds is entirely different. The Fairburn and Argyle earths have been tested in the clarification of cotton seed oil, with excellent results.

MR. O. H. HOWARTH, speaking in the British Association of various strains to which the earth is subjected in its motions around the sun and upon its own axis, ascribed to them the chief responsibility for cracks in the rocky coating of the earth. He supposed that while gravitation tends to draw all the heavier minerals to the center of the earth, this process of shaking or breaking and constant readjustment suffices to spread them out again in the form of fissure veins. The theory was experimentally illustrated by kneading pieces of colored matter in plastic clay, when in a short time little veinlike markings were produced. Possibly such ever-present and ever-shifting strain might account for the disturbances to be seen in the sun.

IT has long been recognized that arsenical wall papers do serious mischief, but it has been much disputed as to just how the arsenic is liberated. This point has recently been cleared up by the researches of Gosio and Emmerling. Certain molds, including the very common *Mucor mucedo*, have been found to have the remarkable property of decomposing arsenical compounds, with the evolution of volatile products containing arsenic of a highly poisonous character.

SOME analyses of coal from the pre-carboniferous rocks of Canada communicated to the British Association by Professor Ellis, of Toronto, showed in a very striking way the gradual transition from petroleum and its immediate product of decomposition, asphalt, to anthracite and pure carbon.

A COMMITTEE for the promotion of agriculture, with Sir John Evans as chairman, was appointed by the British Association to look into the methods and results of the agricultural experiment stations in Canada and other countries, with a view to establishing a similar institution in Great Britain.

THE death has been recently reported of Dr. Holmegren, professor of physiology in the University of Upsala, Sweden. He was born in 1831, and was appointed to his professorship in 1867. He established the first physiological institute in Sweden; but was best known abroad for his researches on color blindness, and his plan of testing the color sense by means of wools of various shades.

DR. EDMUND DRECHSEL, professor of physiological and pathological chemistry and of pharmacology in the University of Bonn, died of heart disease, September 22d, at the Naples Zoölogical Station, where he was investigating the chemistry of the invertebrates. Previous to going to Bonn, he was assistant professor at Leipsic. He published many contributions to physiological chemistry.

DR. GEORGE H. HORN, who died in Philadelphia, November 25th, was one of the most eminent entomologists in America, and was president of the Entomological Society. He was also for many years secretary of the American Philosophical Society, and discharged the duties of that office and of librarian till about a year ago, when he was attacked with paralysis. He served, moreover, for some time as corresponding secretary of the Academy of Natural Sciences of Philadelphia.

THE obituary list for the month includes the names of the following men known in science: The Rev. P. B. Brodie, of Rowington, England, geologist and student of fossil insects, November 11th, aged eighty-two; Prof. Ernst Schering, director of the magnetic department of the observatory at Göttingen, November 2d, aged sixty-four; Sir Rutherford Alcock, formerly president of the Royal Geographical Society, November 2d, aged eighty-eight; C. E. Colby, professor of organic chemistry in Columbia University; Dr. Harrison Allen, emeritus professor of comparative anatomy in the University of Pennsylvania, November 14th; Sir Henry Doulton, founder of the Lambeth Potteries, November 17th, aged seventy-seven; Dr. G. H. Otto Vogler, author in geology and natural history, October 18th, aged seventy-five; Prof. Henry Calderwood, Edinburgh, writer on philosophy and evolution; Dr. J. Frenzel, director of the Biological Station on the Muggelsee, near Berlin; Dr. L. A. Büchner; Prof. Karl Müller, of Hildesheim; Dr. M. Foster Heddle, mineralogist and twenty-two years professor in the University of St. Andrews; Dr. F. Stohmann, honorary professor of agriculture in the University of Leipsic; Dr. Leonhard Sohncke, professor of experimental physics in the Technical High School, Munich, aged fifty-five; and the Rev. Samuel Haughton, M. D., former professor of geology in Trinity College, Dublin, and writer on various subjects in science.

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